



THE  
Tea Research Institute  
OF  
Ceylon

BULLETIN No. 28

Annual Report for the Year  
1946



Published by  
THE TEA RESEARCH INSTITUTE OF CEYLON,  
ST. COOMBS, TALAWAKELLE.



# The Tea Research Institute of Ceylon.

## SCIENTIFIC STAFF.

Director ... Roland V. Norris, D.Sc. (Lond.),  
M.Sc. (Manc.), F.R.I.C.

### Department of Entomology.

Entomologist & Deputy Director ... C. H. Gadd, D.Sc. (Birm.)  
Assistant Entomologist ... G. D. Austin  
Assistant ... D. J. W. Ranaweera.  
Field Assistant ... W. T. Fonseka

### Department of Mycology.

Mycologist ... Vacant  
Research Assistant ... C. A. Loos  
Assistant ... S. N. Vander Wal

### Department of Agricultural Chemistry.

Agricultural Chemist ... T. Eden, D.Sc. (Manc.), A.R.I.C.  
Assistant ... E. N. Perera  
Field Assistants ... M. Piyasena  
... F. P. Jayawardana

### Department of Biochemistry.

Biochemist ... J. Lamb, M.Sc. (Lond.), A.R.I.C.,  
A.I.C.T.A.  
Research Assistant ... M. S. Ramaswamy, B.Sc. (Mysore)  
Assistants ... F. L. Keegel  
... V. Mendis  
... S. M. Gunaratnam

### Department of Plant Physiology.

Plant Physiologist ... F. R. Tubbs, Ph.D. (Lond.), M.Sc.  
(Lond.), D.I.C., A.R.C.S. F.L.S.  
Assistant ... E. S. Rajiah  
Field Assistant ... F. H. Kehl

### Small-Holdings Officers.

R. L. Illankoon  
F. D. Tillekeratne  
(Vacant)

Superintendent, St. Coombs Estate ... F. C. Daniel

## NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.



# TWENTY-FIRST ANNUAL REPORT

OF THE

## BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON

FOR 1946

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**Foundation.**—The Tea Research Institute was established by Ordinance No. 12 of 1925, dated the 27th October, 1925. The Constitution of the Board is laid down in that Ordinance; the personnel on the 1st day of January, 1946, was:—

*Ex-Officio Members.*

The Hon'ble the Financial Secretary (Hon'ble Sir Oliver Goonetilleke, K.B.E., C.M.G.)

The Director of Agriculture (Mr. L. J. de S. Seneviratne, C.C.S.)

The Chairman, Planters' Association of Ceylon (Mr. R. Singleton Salmon)

The Chairman, Ceylon Estates Proprietary Association (Mr. E. E. Spencer).

*Representatives of the Planters' Association of Ceylon.*

Mr. R. C. Scott, C.B.E. (Chairman).

Mr. H. S. Hurst.

Mr. R. Gorton Coombe.

*Representatives of the Ceylon Estates Proprietary Association.*

Major J. W. Oldfield, C.M.G., O.B.E., M.C., M.S.C.

Mr. J. C. Kelly.

Mr. W. H. Gourlay.

*Representative of the Low-Country Products' Association.*

Mr. F. Amarasuriya.

*Representative of the Small-Holders.*

Mr. R. C. Kannangara, M.S.C.

*Chairman.*—Mr. R. C. Scott, C.B.E.

*Secretary.*—Dr. Roland V. Norris.

*Solicitors.*—Messrs. Julius & Creasy.

*Auditors.*—Messrs. Ford, Rhodes, Thornton & Co.

*Registered Office.*—Office of the Planters' Association of Ceylon, Kandy.

The following changes in the composition of the Board took place during the year:—

Mr. W. H. Gourlay resigned on the 8th January and Mr. D. T. Richards was nominated by the Ceylon Estates Proprietary Association to replace him.

Major J. W. Oldfield, C.M.G., O.B.E., M.C., M.S.C. resigned with effect from the 11th April and was succeeded by W. H. Attfield.

Mr. T. Wilkinson Kay was nominated by the Planters' Association of Ceylon to take the place of Mr. R. Gorton Coombe who resigned with effect from the 17th May.

Mr. E. G. Groves was nominated by the Planters' Association of Ceylon to act for Mr. R. C. Scott, C.B.E., on leave, with effect from the 17th May.

Mr. D. T. Richards proceeded on leave on the 17th July, 1946 and Mr. F. A. Bond was nominated by the Ceylon Estates Proprietary Association to act for him.

Mr. C. A. Meakin became an *ex-officio* member of the Board as Chairman of the Ceylon Estates Proprietary Association *vice* Mr. E. E. Spencer resigned.

Mr. S. Vytilingam, M.S.C. was nominated by H. E. the Governor to represent the Small-Holders *vice* Mr. R. C. Kannangara, M.S.C. (deceased).

It is with great regret that the death of the late Mr. R. C. Kannangara, which occurred on the 14th October, 1946, has to be recorded. Mr. Kannangara was nominated by H. E. the Governor in April, 1945 to represent the Small-Holders and the eighteen months he served on the Board provided ample evidence of the great interest he took in those he represented and the general business of the Board. A vote of condolence with his relatives was recorded by the Board at its meeting on the 13th December, 1946.

Major Oldfield's resignation in April severed a connection with the Board which has been continuous since its inception. He took a notable part in the formation of the Tea Research Institute, was the first Chairman, and his progressive outlook and fertility in constructive suggestion were invaluable to the Institute throughout his many years of service. It is a matter of great regret to the Board and Staff of the Institute that this long connection with the Institute has now come to an end.

The thanks of the Board are due to the other gentlemen who held acting appointments during the year.

#### COMMITTEES.

**Finance Sub-Committee.**—The Chairman, Tea Research Institute of Ceylon, the Chairman, Planters' Association of Ceylon, the Chairman, Ceylon Estates Proprietary Association, Major J. W. Oldfield, C.M.G., O.B.E., M.C., M.S.C., Mr. R. Singleton Salmon and the Director, Tea Research Institute.

Mr. W. H. Attfield took the place of Major Oldfield during the year and Mr. D. T. Richards was appointed to act in the temporary vacancy caused by Mr. R. C. Scott's absence on leave. When later in the year Mr. D. T. Richards also proceeded on leave Mr. F. A. Bond took his place.



The Committee held two meetings during the year.

**Experimental Sub-Committee**—The Director, Tea Research Institute (Chairman), the Chairman, Tea Research Institute, the Visiting Agent (Mr. A. H. Hall), the Superintendent, St. Coombs, Messrs. R. G. Coombe, D. T. Richards, R. H. Horne, W. J. Craig, E. de la Mare, G. K. Newton and Dr. T. Eden (Convener).

Messrs. R. G. Coombe and W. J. Craig resigned during the year and were succeeded by Messrs. H. S. Hurst, and P. B. Cruickshank.

Mr. S. Bolster and Mr. T. Kane were appointed to act for Mr. R. C. Scott and Mr. R. H. Horne, respectively when the latter proceeded on leave.

Mr. Coombe's resignation from the Committee on which he had served since its formation, marks another break of continuity and was greatly regretted by his colleagues. Grateful thanks are also due to Mr. Craig for his services.

The Committee held three meetings during the year.

**Medical Scheme Sub-Committee**.—The Chairman, T.R.I., the Director, T.R.I., and Mr. G. D. Austin (representing the Junior Staff).

**Trustees of the Junior Staff Provident Fund**.—The Chairman, T.R.I., the Director, T.R.I., Mr. J. C. Kelly and Mr. E. N. Perera (representing the Junior Staff).

**Visiting Agent**.—Mr. A. H. Hall continued as Visiting Agent to St. Coombs and the Board is much indebted to him for his services during the year.

#### FINANCE .

The total receipts for the year were Rs. 465,240, comprising Research Cess Rs. 408,431, Profit from St. Coombs Estate Rs. 46,795 and Interest and Miscellaneous Receipts Rs. 10,014. There was little difference from 1945 in the last two figures, but the cess was Rs. 83,301 higher. As a result the receipts for the year were Rs. 83,493 above those for 1945.

Expenditure on Revenue Account amounted to Rs. 397,882 as against Rs. 373,794, the details being Research Revenue Expenditure Rs. 346,273, Interest on Government Loan Rs. 25,565 and Depreciation Rs. 26,044. It may be noted that the Research Revenue Expenditure included a non-recurring item of Rs. 14,214 representing the payment of a retiring gratuity to one of the staff.

The balance on Revenue Account, after allowing for depreciation, therefore amounted to Rs. 67,358, the corresponding figure for 1945 being Rs. 7,953. Capital expenditure (nett) was incurred to the extent of Rs. 87,611 this comprising Rs. 38,535 on assets and Rs. 49,076 in repayment of the Government Loan. The greater part of the expenditure on assets was in connection with the installation of a sprinkler installation in St. Coombs factory. This work will be completed early in 1947.

Nett liquid assets as at the 31st December, 1946, after allowing for specific liabilities such as the accrued interest on the Government Loan and Furlough and Passages Reserve, amounted to Rs. 525,760. The liability under the Depreciation Reserve at the same date was Rs. 597,720. The latter reserve was therefore covered to the extent of 80 per cent only.

**ST. COOMBS ESTATE.**

Fertilisers on the rationed basis were regularly received during the year. Weather conditions were generally favourable and, as a result of these two factors, a record crop of 235,706 pounds was obtained. This was 33,899 pounds in excess of 1945 and was equivalent on the old tea to a yield of 821 pounds per acre. With the exception of 2,698 pounds used for local consumption the entire crop was sold to the Ministry of Food and realised 126.97 cents nett as against 118.89 cents in 1945.

The cost of production at 105.67 cents (including Dearness Allowance for Staff and Labourers at 29.23 cents) was 10.87 cents higher than in the previous year.

The profit on estate working amounted to Rs. 47,795, the corresponding figure for 1945 being Rs. 46,015.

Blister Blight disease was reported in Ceylon at the end of October, 1946 and was first observed on St. Coombs in the first week of December. This was too late in the year to affect the general position and it remains to be seen what will be the ultimate result.

**PUBLICATIONS.**

Normal publication of the *Tea Quarterly* was resumed in 1946 and one Bulletin, the Annual Report for 1945, was also issued.

**ACKNOWLEDGMENTS.**

The Board has, as usual, the pleasant task of acknowledging the co-operation and assistance received from the Ceylon Association in London, the Planters' Association of Ceylon, and the Ceylon Estates Proprietary Association.

Thanks are also due to the Ceylon Tea Propaganda Board who made their Committee Room available for meetings of the Board.

The Audited Statement of Accounts and the Balance Sheet for 1946 are attached, together with the report of the Visiting Agent and those of the Director and Scientific Staff dealing with the research activities of the Institute.

ROLAND V. NORRIS,  
*Secretary.*



# THE TEA RESEARCH INSTITUTE OF CEYLON

## BALANCE SHEET AS AT 31st DECEMBER, 1946

| LIABILITIES                                        |            | ASSETS                                                         |            |
|----------------------------------------------------|------------|----------------------------------------------------------------|------------|
|                                                    | Rs. Cts.   |                                                                | Rs. Cts.   |
| <b>CREDITORS :—</b>                                |            | <b>DEBTORS :—</b>                                              |            |
| Accrued Interest on Loan                           | 5 885.25   | Principal Collector of Customs                                 | 44,461.48  |
| Sundry Creditors—Estate                            | 18,257.96  | Contribution for Upkeep of Mattakelle Cart Road                | 250.00     |
| Sundry Creditors—Research                          | 10,916.85  | M. H. E. Koch                                                  | 12.00      |
| Subscriptions for Publications received in advance | 84.94      | Advertising                                                    | 668.50     |
|                                                    |            | Dr. T. E. T. Bond                                              | 287.30     |
|                                                    |            | Fertiliser Control Bureau                                      | 233.77     |
|                                                    |            |                                                                | 45,913.05  |
| <b>FURLOUGH PROVISION :—</b>                       |            | <b>DEBTORS—RESEARCH :—</b>                                     |            |
| At 31st December, 1945                             | 25,725.76  | Ceylon Association in London £470-4-10 at 1/6                  | 6,269.89   |
| Additions during 1946                              | 30,083.00  | Research Staff                                                 | 457.22     |
|                                                    | 55,808.76  | Deposits, etc.                                                 | 153.75     |
| Less : Payments in 1946                            | 40,405.36  | Accrued Interest on Fixed Deposits & Investments               | 2,482.71   |
|                                                    |            |                                                                | 9,363.57   |
| <b>DEPRECIATION PROVISION :—</b>                   |            | <b>ESTATE</b>                                                  | 148.66     |
| At 31st December, 1945                             | 572,930.91 | <b>STOCKS-IN-HAND :—</b>                                       |            |
| Added at 31st December, 1946                       | 25,658.96  | Tea 36,713 lbs. at prices since realised                       | 47,048.57  |
|                                                    | 598,589.87 | Stocks on Estate                                               | 15,624.61  |
| Less : Items scrapped in 1946                      | 870.49     |                                                                | 62,673.18  |
|                                                    |            | <b>INVESTMENTS—(At Cost) :—</b>                                |            |
|                                                    |            | £2,300-0-0 3½% War Loan Bearer Bonds                           | 32,434.76  |
|                                                    |            | £2,063-18-1 4% Funding Loan 1960/90                            | 29,928.06  |
|                                                    |            | £6,750-0-0 2½% National War Bonds 1952/54                      | 90,000.00  |
|                                                    |            | Rs. 30,000/- Ceylon Govt. Loan 1957/62                         | 29,512.50  |
|                                                    |            | Rs. 15,000/- 3% Defence Bonds 1952                             | 15,000.00  |
|                                                    |            | Rs. 20,000/- 3% do 1949                                        | 20,000.00  |
|                                                    |            | Rs. 40,000/- 3½% Ceylon Government National Loan 1956          | 40,000.00  |
|                                                    |            | Rs. 50,000/- 2½% Ceylon Government War Loan 1954               | 50,000.00  |
|                                                    |            | Rs. 30,000/- 3% Ceylon Govt. National Development Loan 1965/70 | 30,000.00  |
|                                                    |            |                                                                | 336,875.32 |

Carried over Rs. 648,267.78

Carried over Rs. 454,978.78

# THE TEA RESEARCH INSTITUTE OF CEYLON

## BALANCE SHEET AS AT 31st DECEMBER, 1945—(contd.)

| LIABILITIES       |                | ASSETS                             |                        |
|-------------------|----------------|------------------------------------|------------------------|
|                   | Rs. Cts.       |                                    | Rs. Cts.               |
| Brought forward   | Rs. 648,267.78 | Brought forward                    | Rs. Cts.<br>454,973.78 |
| CASH:—            |                | On Current Account                 | 79,578.47              |
|                   |                | On Fixed Deposit                   | 19,087.60              |
|                   |                | On Petty Cash                      | 496.42                 |
|                   |                |                                    | <u>99,162.49</u>       |
|                   |                | Estate—In hand                     | 917.86                 |
|                   |                | N.B.I. Ltd., Colombo               | 21,248.86              |
|                   |                | Stamps                             | 5.00                   |
|                   |                |                                    | <u>22,171.72</u>       |
|                   |                |                                    | <u>121,334.21</u>      |
| FUNDS OVERSPENT:— |                |                                    |                        |
|                   |                | To 31st December, 1945             | 51,706.69              |
|                   |                | Net Capital Expenditure 1946       | 38,535.64              |
|                   |                | Government of Ceylon Loan Account  | 49,075.61              |
|                   |                |                                    | <u>139,317.94</u>      |
|                   |                | Less: Revenue Account Surplus 1946 | 67,358.15              |
|                   |                |                                    | <u>71,959.79</u>       |
|                   |                |                                    | <u>Rs. 648,267.78</u>  |

We have examined the above Balance Sheet with the books of the Tea Research Institute of Ceylon and have obtained all the information and explanations required by us. The allocations of Capital Expenditure and of Research Revenue Expenditure as made by the Director have been accepted by us. In our opinion, the foregoing Balance Sheet is properly drawn up so as to exhibit a true and correct view of the financial affairs of the Institute as at 31st December, 1946, according to the best of our information and the explanations given to us, and as shown by the books.

(Sgd.) FORD, RHODES, THORNTON & CO.,  
Chartered Accountants.



# THE TEA RESEARCH INSTITUTE OF CEYLON

## ESTATE WORKING ACCOUNT AS AT 31st DECEMBER, 1946

### EXPENDITURE

To ESTATE EXPENDITURE—REVENUE  
 „ BALANCE CARRIED FORWARD

| Rs. Cts.   | Rs. Cts.                    | Rs. Cts.     |
|------------|-----------------------------|--------------|
| 251,147-14 | 251,147-14                  | 232,361 lbs. |
| 46,794-58  | 46,794-58                   | 317 „        |
|            | Do —LOCAL                   | 317-00       |
|            | Do —BROKEN MIXED            | 58-40        |
|            | Do —BIOCHEMICAL DEPT.       | 184-00       |
|            | „ MOTOR ROAD ROLLER WORKING | 35-45        |

Rs. 297,941-72

Rs. 297,941-72

## REVENUE ACCOUNT AS AT 31st DECEMBER, 1946

Rs. Cts. Rs. Cts.

### To ADMINISTRATION OF THE BOARD:—

Planters' Association of Ceylon 240-00  
 Travelling of the Board 2,144-75  
 Clerical Staff 9,255-90  
 Telephone Operators 1,006-65  
 Office Peon 768-71  
 Postages 584-19  
 Stationery 1,743-70  
 Advertising 370-72  
 Telegrams, Trunk Calls, 183-03  
 Printing 34-20  
 Legal Expenses 63-00  
 Auditors' Fee 790-32  
 Contingencies 164-89  
 Dearness Allowance 4,503-91

Carried over Rs. 21,853-97

### By BALANCE FROM ESTATE WORKING ACCOUNT

„ Tea Cess ... 408,430-98  
 „ MISCELLANEOUS RECEIPTS ... 33-73  
 „ INTEREST ... 9,889-86  
 „ GUEST HOUSE INCOME ... 91-25

Carried over Rs. 465,240-40

## THE TEA RESEARCH INSTITUTE OF CEYLON

## REVENUE ACCOUNT AS AT 31st DECEMBER, 1946—(contd.)

|                                                          | Rs.         | Cts. | Rs.     | Cts. |                                |
|----------------------------------------------------------|-------------|------|---------|------|--------------------------------|
| To PERSONAL EMOLUMENTS OF<br>SCIENTIFIC STAFF:—          |             |      |         |      | Rs. Cts.                       |
| Director                                                 | 23,900      | 00   |         |      |                                |
| Entomologist                                             | 20,250      | 00   |         |      |                                |
| Agricultural Chemist                                     | 20,250      | 00   |         |      |                                |
| Share of Superintendent's Salary                         | 330         | 00   |         |      |                                |
| Plant Physiologist                                       | 18,000      | 00   |         |      |                                |
| Biochemist                                               | 17,130      | 85   |         |      |                                |
| Mycologist                                               | 8,274       | 59   |         |      |                                |
| Dearness Allowance                                       | 13,245      | 15   |         |      |                                |
|                                                          |             |      | 121,380 | 59   |                                |
| " EMOLUMENTS—JUNIOR AND<br>SUB-SCIENTIFIC STAFF:—        |             |      |         |      |                                |
| Junior Scientific Staff                                  | 45,860      | 88   |         |      |                                |
| Lab. Attendants and Fieldman                             | 5,031       | 38   |         |      |                                |
| Dearness Allowance                                       | 14,398      | 16   |         |      |                                |
|                                                          |             |      | 65,290  | 42   |                                |
| " LABORATORY:—                                           |             |      |         |      |                                |
| Equipment and General<br>Working Expenses                | 5,909       | 78   |         |      |                                |
| Special Provision for Joint Research<br>Chemistry on Tea | 2,508       | 72   |         |      |                                |
| Furniture and Office Equipment                           | 252         | 05   |         |      |                                |
|                                                          |             |      | 8,670   | 55   |                                |
| " LIBRARY AND PUBLICATIONS:—                             |             |      |         |      |                                |
| Library                                                  | 2,417       | 46   |         |      |                                |
| Publications                                             | 354         | 95   |         |      |                                |
|                                                          |             |      | 2,062   | 51   |                                |
| " SMALL-HOLDINGS:—                                       |             |      |         |      |                                |
| Salaries and House Allowances                            | 14,255      | 72   |         |      |                                |
| Travelling and General<br>Expenditure                    | 3,998       | 81   |         |      |                                |
| Dearness Allowance                                       | 2,056       | 20   |         |      |                                |
|                                                          |             |      | 20,310  | 73   |                                |
| Brought forward                                          |             |      | 21,853  | 97   |                                |
|                                                          |             |      |         |      | Rs. Cts.                       |
|                                                          |             |      |         |      | Brought forward Rs. 465,240·40 |
| Carried over                                             | Rs. 239,568 | 77   |         |      | Carried over Rs. 465,240·40    |



# THE TEA RESEARCH INSTITUTE OF CEYLON

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## REVENUE ACCOUNT AS AT 31st DECEMBER, 1946—(contd.)

Rs. Cts.  
Brought forward 465,240-40

Rs. Cts.  
Brought forward 239,568-77

### To FIELD AND FACTORY EXPERIMENTS:—

|                                 |           |
|---------------------------------|-----------|
| Agricultural Chemist            | 5,941 36  |
| Plant Physiologist              | 1,766-47  |
| Miscellaneous Field Experiments | 262-70    |
| Factory Experiments             | 3,659-52  |
|                                 | 11 630 05 |

### " TRAVELLING OF STAFF:—

|                              |          |
|------------------------------|----------|
| Officers' Expenses           | 2,728-52 |
| Insurance of Car and License | 188-22   |
| Driver's Wages               | 828-00   |
| Driver's Batta               | 268-00   |
| Running Expenses and Repairs | 2,213-07 |
| Dearness Allowance           | 601-64   |
|                              | 6,827-45 |

### MAINTENANCE OF BUILDINGS:—

|                                                                    |           |
|--------------------------------------------------------------------|-----------|
| Laboratory                                                         | 3,165-16  |
| Six Senior Staff Bungalows                                         | 3,518-50  |
| Junior Staff Bungalows                                             | 3,963-78  |
| Clerks' Bungalows                                                  | 340-29    |
| Miscellaneous Lines and Buildings                                  | 872-59    |
| Passara Buildings                                                  | 78-35     |
| Guest House                                                        | 57-92     |
| Replacement and Renewals Junior Staff and Clerical Staff Furniture | 1,176-15  |
|                                                                    | 13,172-74 |

### " GENERAL SERVICES:—

|                                  |           |
|----------------------------------|-----------|
| Electric Power                   | 8,190-78  |
| Mechanic                         | 920-00    |
| Telephones, Rent and Maintenance | 610-75    |
| Roads                            | 600-00    |
| Sanitation                       | 1,178-78  |
| Water Supply                     | 1,987-41  |
| Tappal, Lorry and Book Fees      | 254-00    |
| Upkeep of Grounds                | 1,155-87  |
| Guest House                      | 705-11    |
| Dearness Allowance               | 3,683-14  |
|                                  | 19,295-84 |

Carried over Rs. 290,494-85

Carried over Rs. 465,240-40

THE TEA RESEARCH INSTITUTE OF CEYLON

| REVENUE ACCOUNT AS AT 31st DECEMBER, 1946—(contd.)    |         |            |
|-------------------------------------------------------|---------|------------|
|                                                       | Rs.     | Cts.       |
| Brought forward                                       | 290,494 | 85         |
| to MISCELLANEOUS:—                                    |         |            |
| Incidentals ..                                        | 184     | 70         |
| Provident Fund, Senior Sc. Staff                      | 10,719  | 53         |
| Do Junior Scientific Staff                            | 5,842   | 70         |
| Do Sub-Staff ..                                       | 1,664   | 54         |
| Passages ..                                           | 15,000  | 00         |
| Ceylon Nursing Association and Fraser Nursing Home .. | 240     | 00         |
| Medical Fees, Sub-Staff ..                            | 541     | 89         |
| Medical Fees, Junior Staff ..                         | 1,188   | 00         |
| Insurances ..                                         | 4,095   | 53         |
| Watchmen and Caretakers ..                            | 941     | 50         |
| Observatory Allowance ..                              | 240     | 00         |
| Dearness Allowance ..                                 | 904     | 87         |
| RETIRING GRATUITY (Non-Recurent)                      | 14,214  | 39         |
| GOVERNMENT OF CEYLON LOAN INTEREST ..                 | 25,565  | 30         |
| DEPRECIATION ..                                       | 26,044  | 45         |
| BALANCE TO "FUNDS OVERSPENT"                          | 67,358  | 15         |
|                                                       | Rs.     | 465,240 40 |

(Sgd.) ROLAND V. NORRIS,  
*Director.*



# THE TEA RESEARCH INSTITUTE OF CEYLON

BULLETIN No. 28.

| Dr.                           | CAPITAL ACCOUNT AS AT 31st DECEMBER, 1946 |                  |                 |                     | Cr.                                               |          |
|-------------------------------|-------------------------------------------|------------------|-----------------|---------------------|---------------------------------------------------|----------|
|                               | EXPENDITURE                               |                  | RECEIPTS        |                     |                                                   |          |
|                               | To<br>31-12-45                            | Rs. Cts.         | Rs. Cts.        | Rs. Cts.            | Rs. Cts.                                          | Rs. Cts. |
| To LAND—INCLUDING DEVELOPMENT | 900,972-07                                | 1,697-21         | —               | 902,669-28          | By GOVERNMENT OF CEYLON:—                         |          |
| „ BUILDINGS & LINES           | 938,324-05                                | 32,129-24        | —               | 970,453-29          | Loan on Mortgage @ 5½% per annum                  |          |
| „ FURNITURE AND EQUIPMENT     | 82,548-23                                 | —                | 385-49          | 82,162-74           | Less: Repayments to 1946                          |          |
| „ LABORATORY EQUIPMENT        | 43,409-68                                 | 65-42            | 870-49          | 42,604-61           | „ REVENUE APPLIED TO CAPITAL PURPOSES TO 31-12-45 |          |
| „ EXPERIMENTAL MACHINERY      | 29,705-38                                 | —                | —               | 29,705-38           | Add SURPLUS 1946                                  |          |
| „ MACHINERY—ESTATE            | 148,877-48                                | 1,399-75         | —               | 150,277-23          | „ FUNDS OVERSPENT AS AT 31-12-45                  |          |
| „ MOTOR ROAD ROLLER           | 7,386-03                                  | —                | —               | 7,386-03            | do 1946                                           |          |
| „ MOTOR CAR                   | 4,025-00                                  | 8,525-00         | 4,025-00        | 8,525-00            |                                                   |          |
|                               | <u>Rs. 2,155,247-92</u>                   | <u>43,816-62</u> | <u>5,280-98</u> | <u>2,193,783-56</u> |                                                   |          |
|                               |                                           |                  |                 |                     | Rs. 2,193,783-56                                  |          |
|                               |                                           |                  |                 |                     | (Sgd.) ROLAND V. NORRIS,                          |          |
|                               |                                           |                  |                 |                     | Director.                                         |          |





# REPORT

ON

## ST. COOMBS ESTATE

### FOR 1946

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**Superintendent.**—Mr. F. C. Daniel was confirmed in this appointment in November, 1946, having been acting for 9 months previously.

**Acreage :—**

|                                     |     |     |     |   |    |
|-------------------------------------|-----|-----|-----|---|----|
| Tea in full bearing                 | ... | ... | 284 | 1 | 06 |
| Tea in partial bearing (1938)       | ... | ... | 16  | — | —  |
| Tea nurseries                       | ... | ... | 1   | 1 | 08 |
| Fuel clearings                      | ... | ... | 36  | — | —  |
| Reserve land available for planting | ... | ... | 27  | 1 | 09 |
| Building Sites, etc.                | ... | ... | 26  | 2 | 22 |
| Waste Land and Swamps               | ... | ... | 23  | 1 | 14 |
| Total                               |     |     | 414 | 3 | 19 |

The estate has been surveyed again but the new plan was not received before the close of the year.

The Tea in partial bearing (1938), 16 acres, came into full bearing during the last quarter of the year.

**Weather.**—(Estate Gauge).

|                    |     | Rainfall   | Wet Days |
|--------------------|-----|------------|----------|
| Registered in 1946 | ... | 91.35 ins. | 229 days |
| Registered in 1945 | ... | 73.79 ins. | 197 days |

**Crop :—**

The crop harvested for 1946 was a record for the estate.

|                                     |     | 1946.        | 1945.        |
|-------------------------------------|-----|--------------|--------------|
| Estimate                            | ... | 220,000 lbs. | 220,000 lbs. |
| Total crop (including Broken Mixed) | ... | 235,706 lbs. | 201,813 lbs. |

**Yield per acre :—**

|                         |     | 1946     |             | 1945     |
|-------------------------|-----|----------|-------------|----------|
| Old Tea (284 acres)     | ... | 821 lbs. | (264 acres) | 710 lbs. |
| Clearings (16 acres*)   | ... | 148 lbs. | —           | —        |
| On whole area 300 acres | ... | 785 lbs. | (284 acres) | 711 lbs. |

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\* Brought into plucking August.

**Prices and Total Crop Sold :—**

| Year |     | Total<br>Crop Sold | Gross<br>Price | Nett<br>Price |
|------|-----|--------------------|----------------|---------------|
| 1946 | ... | 233,008 lbs.       | 127.85 cts.    | 126.97 cts.   |
| 1945 | ... | 199,365 lbs.       | 119.79 cts.    | 118.89 cts.   |

**Cost of Production :—**

|          |     | 1946        | 1945       |
|----------|-----|-------------|------------|
| Estimate | ... | 94.35 cts.  | 90.33 cts. |
| Actual   | ... | 105.67 cts. | 94.73 cts. |

Dearness Allowance included in the above figures was :—

|                              |      |     | 1946       | 1945       |
|------------------------------|------|-----|------------|------------|
| Senior and Subordinate Staff | ...  |     | 2.63 cts.  | 2.33 cts.  |
| Factory Staff : Staff        | 1.26 |     |            |            |
| Labour                       | 2.34 | ... | 3.60 cts.  | 3.02 cts.  |
| Other Labour                 |      | ... | 23.00 cts. | 19.09 cts. |
| Total                        | ...  |     | 29.23 cts. | 24.44 cts. |

**Profit on Estate Working :—**

|      |     |            |
|------|-----|------------|
| 1946 | ..  | Rs. 46,795 |
| 1945 | ... | Rs. 46,015 |

**Capital Expenditure (Gross):—**

|      |     |                               |
|------|-----|-------------------------------|
| 1946 | ... | Rs. 35,209—14.94 cts. per lb. |
| 1945 | ... | Rs. 14,743— 7.37 cts. per lb. |

**Manuring.**—286 acres were manured during 1946, the policy being, as far as possible, to apply the manure 6, 16, and 26 months after pruning, giving 30 lbs., 42 lbs. and 51 lbs. Nitrogen per acre, respectively.

In addition to applications of manure, leaf-fall from prunings, with all green manure available, was forked in as soon as possible after pruning.

**Green Manure.**—*Tephrosia vogelii* was the bush green manure sown this year and good crops were grown.

An effort was made to supply green manure in the older areas. Many *Gliricidia sepium* cuttings were put out and are coming on well, but rather slowly.

Preparations have been made for a more intensive effort during 1947. *Grevilleas*, *Albizzia moluccana* and *Albizzia sumatrana* are being supplied.

**Pruning.**—Clean pruning was done, on a 3-year cycle. Wood is good and the spread of the bushes is being encouraged.

**Weeding.**—The whole estate is on Estate Account at present but contracts will be given out when the new plan is received.



Fields Nos. 9—14 were clean weeded. In Nos. 1—8 *Polygonum nepalense* was retained as a cover.

**Pests and Diseases.**—Blister Blight made its appearance just before the end of the year, but no severe attack was experienced in 1946.

**Labour.**—The force at 417 is sufficient for requirements.

**Lines.**—148 rooms. No new lines were built this year. When new quarters have been built for the Baas, Dhoby, and K.P. some congestion in the lines will be relieved and the position will then be reviewed.

**Factory and Machinery.**—All maintained in good order. It is hoped that the Sprinkler System will be finished early in 1947.

**General.**—The estate is in good order. The crop position is more satisfactory and the standard of field works has improved.

A. H. HALL,

*Visiting Agent.*

## METEOROLOGICAL OBSERVATIONS, 1946.

ST. COOMBS.

(Laboratory Gauges)

| MONTH     | TEMPERATURES    |                                          |                 |                                          | RAINFALL        |                  |                           |        | DAYS                                     |      | SUNSHINE                                 |         |                                          |
|-----------|-----------------|------------------------------------------|-----------------|------------------------------------------|-----------------|------------------|---------------------------|--------|------------------------------------------|------|------------------------------------------|---------|------------------------------------------|
|           | Mean<br>Maximum | Difference<br>from average<br>(15 years) | Mean<br>Minimum | Difference<br>from average<br>(15 years) | Adopted<br>Mean | Mean on<br>grass | Mean Relative<br>Humidity | Inches | Difference<br>from average<br>(15 years) | Days | Difference<br>from average<br>(15 years) | Hours   | Difference<br>from average<br>(15 years) |
| January   | 74.6            | + 0.4                                    | 53.6            | - 1.7                                    | 64.1            | 49.4             | 69                        | 1.93   | - 1.34                                   | 7    | - 3                                      | 203.07  | - 4.52                                   |
| February  | 75.0            | - 1.5                                    | 56.0            | + 1.3                                    | 65.5            | 51.1             | 71                        | 1.62   | - 0.92                                   | 9    | + 1                                      | 192.13  | - 28.21                                  |
| March     | 78.0            | + 0.5                                    | 56.4            | + 1.1                                    | 67.2            | 50.4             | 64                        | 7.01   | + 2.50                                   | 14   | - 2                                      | 217.72  | - 17.22                                  |
| April     | 77.8            | + 0.2                                    | 57.9            | 0.0                                      | 67.8            | 57.2             | 80                        | 7.57   | + 1.20                                   | 13   | - 3                                      | 202.57  | - 2.81                                   |
| May       | 77.9            | + 7.8                                    | 58.8            | - 1.1                                    | 68.4            | 56.0             | 79                        | 2.23   | - 10.99                                  | 11   | - 8                                      | 209.13  | + 50.99                                  |
| June      | 71.6            | + 0.8                                    | 60.7            | + 0.3                                    | 66.2            | 60.8             | 86                        | 8.27   | - 4.16                                   | 25   | - 1                                      | 78.15   | - 21.32                                  |
| July      | 73.0            | + 3.2                                    | 59.9            | + 0.4                                    | 66.4            | 59.9             | 82                        | 7.67   | - 4.97                                   | 24   | - 2                                      | 122.02  | + 14.10                                  |
| August    | 71.3            | + 0.3                                    | 59.8            | + 0.7                                    | 65.6            | 60.0             | 86                        | 15.47  | + 6.16                                   | 28   | + 3                                      | 103.55  | - 13.90                                  |
| September | 74.1            | + 1.9                                    | 57.5            | - 0.8                                    | 65.8            | 56.1             | 78                        | 11.09  | + 2.96                                   | 17   | - 4                                      | 172.35  | + 32.44                                  |
| October   | 75.3            | + 2.0                                    | 57.0            | - 0.9                                    | 66.2            | 54.9             | 80                        | 7.34   | - 2.46                                   | 18   | - 4                                      | 172.65  | + 19.02                                  |
| November  | 73.6            | + 0.3                                    | 57.5            | - 0.1                                    | 65.6            | 56.5             | 84                        | 7.23   | - 0.99                                   | 24   | + 3                                      | 121.42  | - 35.67                                  |
| December  | 72.1            | - 1.7                                    | 57.7            | + 1.7                                    | 64.9            | 56.2             | 84                        | 11.13  | + 5.97                                   | 22   | + 7                                      | 99.53   | - 80.54                                  |
| Annual    | 74.5            | + 1.2                                    | 57.7            | + 0.1                                    | 66.1            | 55.7             | 79                        | 88.56  | - 7.04                                   | 212  | - 9                                      | 1894.29 | - 87.64                                  |

Means

Totals

# REPORT

OF

## THE DIRECTOR

### TEA RESEARCH INSTITUTE OF CEYLON

#### FOR 1946

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**Finance.**—Receipts for 1946 at Rs. 465,240 were markedly higher than in 1945, this being almost entirely due to the large increase in the proceeds from the cess which amounted to Rs. 408,431. Expenditure on Revenue Account, including Rs. 14,215 on a non-recurring item, was Rs. 397,882 as against Rs. 373,795 in 1944. Included in the total of Rs. 397,882 were Rs. 25,565 representing interest on the Government Loan and Rs. 25,044 on depreciation. The surplus on revenue account was, therefore, Rs. 67,358, the corresponding figure for 1945 being Rs. 7,953. Capital expenditure (nett), including Rs. 49,076 paid off against the Government Loan and Rs. 38,535 spent on assets, amounted in all to Rs. 87,611.

In considering the balance on Revenue Account which, it will be seen, was insufficient to cover capital expenditure, it should be noted that the Institute was throughout 1946 without two Senior Officers. Revenue expenditure will, therefore, be at a higher level when a full staff is again available, and the necessity for higher receipts is, therefore, obvious.

Fuller details will be found in the Report of the Board and the Audited Accounts given earlier in this report.

**St. Coombs Estate.**—Fertilisers on the rationed scale were regularly received and, with favourable weather prevailing during most of the year, a crop of 235,706 pounds tea was obtained, equivalent on the old tea to a yield of 821 pounds per acre. The profit on working account for the year was Rs. 47,795, the corresponding figure for 1945 being Rs. 46,015.

Blister Blight which appeared in Ceylon in October 1946 was first seen on St. Coombs early in December. This was, of course, too late to affect the position for the year. Further observations on Blister Blight generally are given later.

Full details in regard to the estate will be found in the Report of the Visiting Agent.

**Staff.**—It was, unfortunately, found impossible during the year to recruit senior staff officers to fill the two vacancies of Mycologist and Scientific Officer. Mr. Lamb proceeded on leave in March and the Director took charge of the Biochemical Division. The Director went on home leave in September after which Dr. C. H. Gadd acted as Director for the rest of the year; Dr. Tubbs assumed charge of the Mycological Division in addition to his own duties as Plant Physiologist and Dr. Eden supervised the work of the Biochemical Division.

Owing to ill-health Mr. J. A. Rogers had, most unfortunately, to relinquish his appointment as Superintendent of St. Coombs Estate which he had held since 1928 when the Institute took over the estate. During his



eighteen years' service with the Institute Mr. Rogers by his loyal and conscientious work did much to develop the estate. The best wishes of all his former colleagues are extended to him and Mrs. Rogers in their retirement. Mr. F. C. Daniel was appointed to succeed Mr. Rogers.

**Fertiliser Rationing and Distribution.**—The Director continued in charge of the Fertiliser Rationing Scheme until he proceeded on leave in September when Dr. T. Eden assumed acting charge.

Difficulties were experienced arising from the fact that Ceylon's indent for nitrogen for the twelve months July 1945/June 1946 could not be met in full, a cut of 15 per cent being made. Furthermore, shipments were irregular and late. It is satisfactory, therefore, that it proved possible, in spite of these difficulties, to maintain distribution to both rubber and tea estates without any cut in the nitrogen quota. Phosphoric acid and potash were in better supply and caused no particular anxiety.

**Advisory Work.**—As was to be expected with a return to more normal conditions, enquiries from estates rapidly increased during the year. Transport difficulties, tyres and petrol in particular, however, still limited the personal contacts between the Institute Staff and Estate Superintendents.

An additional Small-Holdings Advisory Officer was appointed to the Morawak Korale, bringing the number of such officers to three.

## TECHNICAL

**Pests and Diseases.**—It is fortunate, considering the arrival of Blister Blight in Ceylon towards the end of the year, that other pests and diseases were not prominent and these call for no special comment.

Blister Blight, caused by the fungus *Exobasidium vexans*, Møssø, has long been known as a pest of tea in North-East India. There, though from time to time severe local damage may occur, its status as a pest is greatly reduced by the climatic conditions which prevail and by the cultural practices which necessarily follow such conditions, in particular annual pruning. Bushes in N. E. India are out of plucking during the winter months and are pruned during that period. In consequence, recovery from pruning, during which the young buds and shoots are most susceptible to infection, takes place at a time when conditions are most unfavourable to the survival of the fungus spores responsible for spreading the disease. These spores are produced in enormous numbers and it is fortunate indeed that, in contrast with many other varieties of spores, they are relatively susceptible to, and their viability greatly reduced by, high temperatures and dry conditions. It may safely be assumed that it is largely due to this factor that the disease, in the ninety years during which it has been recognised, did not spread at an earlier date to South India or Ceylon. With the speeding up of transport which now enables material to be transported long distances in as many hours as in days or weeks formerly required, it was perhaps inevitable that infections of this nature should now be carried to localities hitherto more or less secure from attack. Be this as it may, the disease appeared in South India in the autumn of 1946 and was reported on an estate in the Dolosbage area of Ceylon late in October. Climatic conditions in Ceylon being much more favourable to its spread than in N. E. India, it is not surprising that in a very brief period it was found in most of the tea districts of the Island. Its subsequent history belongs rather to 1947 than to 1946 but, in view of the fact that the issue of this report has been greatly delayed by the writer's absence from Ceylon

until the middle of the year, and again in August, it may be well to include events occurring at a somewhat later date. In South India, partly no doubt due to the widely scattered nature of the tea districts, which encouraged the hope that the incidence of the disease might possibly be localised, even if the disease could not be eradicated, legislation was hurriedly passed laying down in considerable detail measures to be taken against the disease. When the latter appeared in Ceylon urgent consideration had to be given to the question whether legislation on similar lines should be introduced here. For reasons which appeared sound at the time, and which all later experience has confirmed, it was decided that such legislation would prove ineffective under the conditions prevailing in Ceylon. Attention, therefore, was focussed on obtaining the fullest possible information on the factors which seemed to control or influence the disease in the various tea districts of the Island and devising methods, largely of a cultural character, which could readily be adapted and modified to meet the wide differences in climate and other factors found in different areas. It is obvious that any reliable estimate of the potential danger of the disease can only be made after experience of its incidence under normal monsoon conditions when attacks may be expected to be at their maximum. Pending such information the following extract from a report sent to the Ceylon Association in London presents a picture of the disease and the measures taken during the earlier part of 1947:—

“Before enlarging on some of the subjects dealt with in Dr. Tubbs’ paper,\* it may be as well to clear up one or two special points which arose at your meeting.

“It was suggested that, possibly, the relatively light incidence of attack on St. Coombs might lead the officers of the Institute to underestimate the potential danger of the disease. In fact, attacks on St. Coombs have been quite heavy enough for the Institute to be able to test out the value of the measures advocated both in regard to cultural methods and artificial control by sprays, etc. Our knowledge of the disease, and our assessment of its danger, have, however, been gained by repeated visits to estates in every part of the Island and discussions with planters in every district.

“With regard to other remarks, we are already in the closest contact with producers of fungicidal sprays and dusts and are making every effort to see that the necessary equipment, and such materials as may be found to be of value, will be available for estate use as and when required. In this connection it may be noted that sulphur dusting is quite ineffective. Fungicides of the cuprous oxide type, such as Perenox and similar preparations, on the other hand, are giving very promising results, and may play an important role in dealing with nurseries, young clearings and young pruned fields recovering in the wet season.

“In reference to spraying it should be noted that damage may result from the use of sprays in greater concentration than that advised and from their wasteful application in quantities sufficient to cause ‘run-off’ or ‘drip’ on to the soils of nurseries. Such practices may cause respectively the death of seedlings or copper poisoning of the soil.

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\* A paper given before the Low-Country Products Association

"It was suggested by one speaker that Blister Blight was attacking the jungle. We have so far met no such case. Some jungle trees do from time to time exhibit "blisters" rather similar to Blister Blight but the numerous specimens we have examined confirm that this is due to organisms distinct from Blister Blight. Though some of these infections may be due to a species of *Exobasidium*, this does not attack tea.

"In this connection, it may be mentioned that occasional misapprehension has also arisen over the occurrence of 'red' or 'scarlet' blisters on tea instead of the usual white variety. These do *not* indicate any more virulent race of the fungus and have been observed ever since the disease occurred in Ceylon. They are also found in India. Coloured blisters are found only on certain types of bushes, many of which give similar coloured reactions to wounds by sucking insects, etc.

"The suggestion was made at your meeting that Blister Blight was caused or increased by a deficiency in manuring. The Institute's manurial plots at Passara and St. Coombs have provided an exceptionally favourable means of testing this hypothesis. These plots comprise a complete range of manurial applications of nitrogen, phosphoric acid and potash from nil applications to full doses of all three manures. As these treatments have been maintained continuously for many years, one would expect that any effect of manurial treatment on the incidence of Blister Blight would show up most clearly on these plots. The actual result is that there is no significant difference in the intensity of attack between any of these plots and the idea that manure is a controlling factor cannot be sustained. Adequate manuring is, of course, of great importance, however, in raising the yield in blister-free periods and thus helping to compensate in some degree for the loss of crop during attacks. This aspect has not been lost sight of in pressing Ceylon's case for a liberal fertiliser allocation.

"Passing to a more general summary of the Blister Blight position, Ceylon was fortunate in that the arrival of the disease occurred only a short time before the dry weather of January-March imposed a temporary check. This check gave time for control measures to be devised and brought into action. As was to be expected, however, a sharp recrudescence occurred at the beginning of the South West Monsoon. From the investigational point of view it is unfortunate that the latter has been very light and irregular, as this will cause delay in obtaining a correct picture of the disease under more normal conditions. Actually, with the frequent occurrence of interludes of sunny and relatively dry periods, the disease has received a series of minor checks and its increase has not, generally speaking, been as marked as might have been expected in the hill regions. In the mist zones, however, where conditions of high humidity persist, attacks have been much more severe and the damage to tea which was fairly heavily pruned in April and May has sometimes been considerable. Lighter pruned tea which recovered more quickly suffered much less.

"In Uva, after locally sharp attacks at the end of the North East Monsoon, Blister Blight attacks, as was expected, were reduced in intensity except in a few areas subject to mist or to the over-carry



of the South West monsoon. The amount of blister and the severity of attacks are, in general, much reduced at lower elevations enjoying more sunshine and below 2,000 feet the damage has been light.

"That more serious damage has not occurred and crop figures have been maintained at a satisfactory level, is in no small measure due to the action of the large number of estates which have followed the advice of the Institute to avoid heavy pruning and concentrate on dry weather recovery and lighter tipping. Areas whose pruning has been postponed will be pruned next dry weather so that yields at the end of the year may be expected to drop further than normally would be the case.

"In the South West zone the concentration on dry weather recovery will have some effect on crop in the rush months of April and May next year, but it is essential that the effect of the disease and of the measures at present advocated should only be judged over a reasonably long period.

"In general, therefore, while it may be said that the present position in regard to the disease is more favourable than might have been expected, there is no ground for complacency which could only result in unpleasant repercussions. Estates generally are keeping careful records of attacks and the conditions under which these occur, and such records will provide most useful data on which to base the details of their field programmes. The staff has now gained on the spot a knowledge of the disease considerably in advance of anything previously available from published work outside Ceylon, and the recommendations recently issued are the maximum that can usefully be made *for the moment*. These, however, will be extended or modified in the light of further experience.

"Estates are now fully acquainted with the control measures at present advocated and it is hoped that a short breathing space may be available for the Institute to engage on more fundamental research.

"Finally, attention may be drawn to the fact that certain bushes occur which appear to be immune or, at any rate, much more resistant to attack than others. Similar differences are being observed in the Institute's clonal teas. The fact that these occur may, as a long range measure, assume great importance.

"As in all other major problems, the problem is being approached from every angle by means of team work and the other sections of the Institute are each contributing their share. In particular, the staffs of the Mycological, Entomological and Physiological divisions have been almost entirely diverted to work on Blister Blight, and active assistance has been given by the Biochemical and Agricultural Chemistry departments ever since the disease arrived. This concentration of effort has naturally interfered to some extent with other problems, vegetative propagation, for example, on which the Institute has been working but, in present circumstances, this is unfortunately unavoidable."

**Insect Pests.**—Passing on to insect pests, work on Shot-hole borer has occupied much of the time of the Entomologist. It is of interest to note that, for the first time in the long continued work on this pest, it has proved possible to rear the shot-hole beetle from egg to adult outside its own galleries. This has enabled checks to be made on conclusions reached

by more indirect methods on the life history of the insect. Full details will be found in the report of the Entomologist.

**Agricultural Chemistry.**—Dr. Eden was in charge of St. Coombs Estate up to the 31st May during the absence of the Superintendent, Mr. Rogers, and from the 1st September when the Director went on leave acted as Organiser, Fertiliser Rationing.

These additional duties prevented any expansion in the work of the Department but existing investigations were maintained. In his report will be found a discussion on the carbon and nitrogen status of Ceylon soils, one of the interesting points of which is the evidence provided that, contrary to the view of a certain school of thought, the use of artificial manures does *not* exhaust the soil of either nitrogen or organic matter.

Details are also given of the general results arising from the Institute's manurial trials at St. Coombs and Passara. In the earlier cycles, of two years, at Passara the response to nitrogen was extremely low and it is now clear that this was largely due to the loss of crop resulting from shot-hole borer attacks. By extending the cycle to three years, on the basis of Dr. Gadd's findings that shot-hole borer attack are at their maximum in the second year from pruning and then decrease rapidly, a significant manurial response was shown in the third year. This is of importance in considering the best times of distribution of fertiliser applications in shot-hole borer areas.

Further data have been accumulated in regard to the potash requirements of tea. For the first eleven years of the experiments no yield response was obtained by the use of potash. In the fourth cycle the plots which had throughout received no potash began to fall off and this became more noticeable still in the fifth cycle as might be expected. Ceylon soils are relatively rich in potash but the above results indicate that potash applications cannot be dispensed with, though doses of about 20 lbs.  $K_2O$  normally prove adequate.

**Tea Selection.**—In the department of Plant Physiology, Dr. Tubbs, who returned after six years' war service in December 1945, had naturally to spend an appreciable time studying the records accumulated during his absence and in organising a revised and enlarged programme of work. The most important investigation in this division is, of course, that concerned with tea selection and vegetative propagation. Previous reports have stressed the importance of this problem and the very considerable success which has already been achieved. In Dr. Tubbs' report will be found further and later details of many of the clones now under observation. As already mentioned, considerable interruption necessarily occurred in this work when Blister Blight spread to Ceylon as a very large proportion of Dr. Tubbs' time had to be devoted to this disease. Every effort, however, will be made to remedy this position as it may well prove that, as a long term measure, the ultimate solution of the Blister Blight problem may depend on the finding of more resistant varieties of tea. Already evidence has been secured shewing that a marked variation in susceptibility to the disease does, in fact, occur. Needless to say the selection work of the Institute will be greatly influenced by this consideration.

**Biochemical.**—Reference has been made in earlier reports to work on the chemistry of tea jointly financed by Ceylon, India and the Netherlands

East Indies. This work, which was carried out in London, had to be suspended during the latter part of the war but has now been resumed. The investigations have now been extended to green leaf which is, of course, of greater immediate interest to us than the work previously carried out on made tea. Dr. Bradfield, who is in charge of these investigations, has been highly successful in developing a special analytical technique which, it is clear, will go far to elucidate the nature of the various polyphenols occurring in the leaf and which are the substances which are chiefly concerned in the fermentation of tea. This work, therefore, links up with the investigations on tea fermentation which are being carried out at St. Coombs.

In regard to manufacture, interest has centred chiefly on the development of epicyclic rolling (cone or column rolling). There can be no question that epicyclic rolling offers certain very definite advantages and considerably reduces the cost of manufacture. It is not surprising, therefore, that this subject has aroused considerable interest in the industry. It is particularly unfortunate that in many cases the precautions to be taken in converting rollers to this new system, precautions which have been particularly stressed in the Institute's publications, have not been observed. The results have been that, quite unnecessarily in the majority of cases, the teas produced have sometimes been unfavourably received, particularly with regard to appearance. This is likely to create a prejudice against a method which, when properly used, can turn out teas perfectly satisfactory in all respects. The subject is dealt with in some detail in Mr. Lamb's report and particular stress must be called to the conditions necessary in the first roll. Leaf which undergoes excessive cutting at this stage of manufacture will not later acquire the well developed twist which buyers demand and flaky tea is the result.

**Small-Holdings.**—Advisory work has continued to be carried out in the Gampola, Baddegama and Morawak Korale areas.

**Acknowledgments.**—It is a pleasurable task to acknowledge the interest shewn in our work by the Ceylon Association in London, the Planters' Association of Ceylon and the Low-Country Products Association.

We are particularly indebted to Tea Tasters in Colombo who have most generously given much time and trouble in tasting and reporting on our experimental tea samples. Work on experimental tea manufacture would be quite impossible without this assistance which has been most freely afforded.

Our grateful thanks are also extended to all those, too numerous to refer to individually, who have granted facilities to the staff and received them with great hospitality on their visits to estates.

The Reports of the Scientific Staff are appended.

ROLAND V. NORRIS,  
*Director.*



# REPORT

OF

## THE MYCOLOGIST

FOR 1946

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**Staff.**—The Entomologist, Dr. C. H. Gadd, was in charge of the Mycological Division, in addition to his own duties, until the 15th of September. The Plant Physiologist, Dr. F. R. Tubbs then took charge of the Division on the Entomologist taking over the duties of Acting Director.

The resignation of the Assistant Mycologist, Dr. T. E. T. Bond, took effect on 7th July, Mr. S. N. Vander Wal was appointed Technical Assistant as from 19th of August.

**Publications.**—The following papers were accepted for publication:—

Gadd, C. H. & Loos, C. A.—The ambrosia fungus of *Xyleborus fornicatus* Eich. *Trans. Brit. Myc. Soc.* (Awaiting publication).

Loos, C. A.—Notes on free-living and plant-parasitic nematodes of Ceylon, 3.—*Ceylon Journal of Science Section B.* (Awaiting publication).

**Advisory.**—535 letters were received and 521 despatched. 349 consignments of diseased material were received.

The return of superintendents from war service, and more normal staffing of estates, has allowed of greater attention being paid to pests and diseases than was possible during the latter years of the war. This interest has been reflected in the increase in the number of enquiries received.

With the exception of blister blight, no disease was abnormally prominent during the year, the main interest as usual being in root diseases. Several cases of death after pruning due to deficiency of carbohydrate reserves were recorded, due to failure to leave sufficient leaf surface on bushes pruned at low elevations.

**Consignments of Diseased Material.**—It is desirable to emphasise once again the importance of ensuring that material despatched for examination arrives in a condition that allows of some hope of identifying the disease. The specimen should be reasonably complete. The receipt of a dead branch, for example, provides no opportunity of determining the cause of the death of a whole bush with any degree of certainty. Similarly, in cases of defoliation, it is very desirable that the fallen leaves as well as

the bare stem should be supplied, together with a specimen where leaf-fall is not complete. It is also desirable that diseased bushes should not be lifted from the soil until shortly before their despatch. They should be properly packed in sacks, or in boxes sufficiently robust to ensure arrival intact. Leaves, seedlings and other green material may be wrapped in moss or damp blotting paper and packed in a tin or box. The importance attached to the packing of specimens sent for identification is due to the fact that dried out material permits of the diagnosis of only the most obvious forms of disease. Decision in more difficult cases may be delayed, or rendered impossible.

In conclusion, it may be noted that the practice of briefly notifying the despatch of specimens, or of merely naming the estate on the despatch label, denies those details of locality, soil conditions, area affected, etc., that must be provided if anything more than the mere naming of the disease is desired.

*Rosellinia arcuata*.—This disease is fortunately not as widespread as *Poria*, but when its presence is discovered early measures to prevent its spread should be taken. Where there is a heavy litter of fallen leaves and conditions are persistently moist over a long period, the fungus can spread rapidly through the litter and infect the healthy tea with which it comes in contact. A case of this occurred at St. Coombs during the year, where prunings and litter removed from the site of a new road had been spread in the tea bordering the road. A number of bushes were affected, the disease being entirely confined to the immediate vicinity of the litter.

*Rosellinia bothrina*.—Fructifications of this fungus were discovered on dead tea bushes at St. Coombs. Although Petch reported its occurrence at Hakgala in 1914, it is not known to what extent it is parasitic. Although the field evidence suggests that it is unlikely to become a pest of major importance, it is intended to examine its degree of parasitism on tea.

*The Cercospora disease of tea and green manure plants*.—*Cercospora theae* is well known as causing a leaf disease of tea and acacia, while it is also responsible for a collar rot of *Crotalaria usaramoensis* and *Tephrosia vogelii*. Gadd (T. R. I. Bulletin No. 1. 1926, p. 8) found that under certain cultural conditions *C. theae* produced the perithecia of a *Calonectria* species, though the two species had not been recognised as associated in nature.

What is believed to be a new species of *Cercospora* was observed during the year on plants of *Crotalaria anagyroides* killed by a collar rot. In association with the *Cercospora* were found the bright-coloured perithecia of a *Calonectria*, later proved by cultural methods to be the perfect stage of the *Cercospora* sp.

*The Ambrosia fungus of shot-hole borer galleries*.—The shot-hole borer (*Xyleborus forficatus*) has long been known to live in association with a specific fungus, the so-called Ambrosia fungus, which probably forms the main food of its larvae. This fungus lines the walls of the gallery and may be seen in the galleries in tea and in the castor oil plant as a white, frost-like film, particularly where young larvae are feeding.

The fungi found in the galleries in the two host plants referred to cannot be distinguished as separate strains, though in culture they are easily distinguishable by their colour changes and growth rates. The fungus has been named *Monacrosporium ambrosium*, Gadd and Loos.

Table I.—Number of estates reporting Blister Blight, 1946-47.

| Week ending  | Elevation              |                           |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            | Total | Mean elevation<br>feet |  |
|--------------|------------------------|---------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------|------------------------|--|
|              | 0<br>to<br>500<br>feet | 501<br>to<br>1000<br>feet | 1001<br>to<br>1500<br>feet | 1501<br>to<br>2000<br>feet | 2001<br>to<br>2500<br>feet | 2501<br>to<br>3000<br>feet | 3001<br>to<br>3500<br>feet | 3501<br>to<br>4000<br>feet | 4001<br>to<br>4500<br>feet | 4501<br>to<br>5000<br>feet | 5001<br>to<br>5500<br>feet | 5501<br>to<br>6000<br>feet | 6001<br>to<br>6500<br>feet |       |                        |  |
| 1946         |                        |                           |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            |       |                        |  |
| 31st October |                        |                           |                            |                            | 1                          |                            | 1                          |                            |                            |                            |                            |                            |                            | 1     | 2250                   |  |
| 7th November |                        |                           |                            |                            |                            |                            |                            |                            | 1                          |                            |                            |                            |                            | 1     | 3250                   |  |
| 14th do      |                        |                           |                            |                            | 2                          |                            | 1                          |                            | 2                          |                            |                            |                            |                            | 2     | 4000                   |  |
| 21st do      |                        |                           |                            |                            | 1                          |                            |                            |                            |                            |                            |                            |                            |                            | 6     | 3400                   |  |
| 28th do      |                        |                           |                            |                            | 3                          |                            | 1                          | 3                          |                            | 1                          |                            |                            |                            | 7     | 3200                   |  |
| 5th December |                        |                           |                            | 1                          |                            |                            | 3                          | 4                          | 5                          |                            |                            |                            |                            | 18    | 3300                   |  |
| 12th do      |                        |                           | 3                          |                            | 1                          | 2                          | 4                          | 4                          | 3                          | 2                          |                            |                            |                            | 19    | 3250                   |  |
| 19th do      |                        | 1                         | 1                          |                            | 1                          | 1                          | 4                          | 2                          | 2                          | 2                          |                            |                            |                            | 14    | 3250                   |  |
| 26th do      |                        |                           |                            | 1                          | 2                          | 1                          | 3                          | 2                          | 7                          | 4                          |                            |                            |                            | 20    | 3750                   |  |
| 1947         |                        |                           |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            |                            |       |                        |  |
| 2nd January  |                        |                           |                            | 6                          | 4                          | 8                          | 4                          | 11                         |                            | 3                          | 3                          |                            |                            | 50    | 3450                   |  |
| 9th do       |                        |                           | 3                          | 1                          | 5                          | 3                          | 3                          |                            | 11                         | 2                          | 4                          |                            | 1                          | 24    | 3000                   |  |
| 16th do      | 1                      | 2                         |                            | 5                          | 3                          |                            | 5                          | 8                          |                            |                            |                            |                            | 2                          | 40    | 3300                   |  |
| 23rd do      |                        | 4                         | 1                          | 1                          | 1                          |                            | 2                          | 4                          | 1                          | 5                          |                            | 1                          |                            | 20    | 3200                   |  |
| 30th do      | 3                      | 2                         | 1                          | 3                          | 2                          |                            | 2                          | 1                          |                            | 2                          | 1                          |                            |                            | 17    | 2250                   |  |
| 6th February | 1                      | 4                         |                            | 4                          |                            | 1                          |                            | 3                          | 4                          | 1                          | 2                          | 1                          | 1                          | 22    | 3110                   |  |
| 13th do      |                        |                           |                            | 2                          | 2                          |                            | 4                          | 2                          | 2                          |                            |                            |                            |                            | 19    | 3120                   |  |
| 20th do      |                        |                           |                            |                            |                            |                            |                            | 1                          | 2                          |                            | 2                          |                            |                            | 5     | 4550                   |  |
| 27th do      | 1                      |                           |                            |                            |                            |                            |                            |                            | 1                          |                            | 2                          |                            |                            | 4     | 3750                   |  |



*Nematodes*.—The meadow nematode, *Pratylenchus pratensis*, has been reported from a further five estates during the year. The distribution of estates where bearing tea is now known to be affected is as follows:—

Hewaheta (5), Galaha (1), Uda-Pussellawa (1), Halgranoya (1), Maturata (2), Kotagala (4), Talawakelle (1), Lindula (4), Bogawantalawa (3), Haputale (2).

*Blister Blight*.—Blister blight of tea, caused by the fungus *Exobasidium vexans* Massee, was discovered for the first time in Ceylon on the 28th of October on specimens received from Dolosbage. A few days later it was reported from an estate in Pussellawa. In the ensuing three weeks it was found in four other widely dispersed districts in the western zone. Thereafter additional reports were received in increasing numbers from each of the affected districts, and also from other districts on the west of the Island.

The incubation period of the disease being three weeks, it seems extremely probable that the earlier isolated outbreaks were distinct from, and not a result of, the first reported occurrence in Dolosbage. Subsequent outbreaks may have been due to the airborne movement of spores originating in Ceylon or further fresh infections from South India or elsewhere. The subsequent occurrence of the disease is shown in Table I

The eastern districts were first infected during the North-East Monsoon, and it is of interest to record that currents of air from the South-West had been observed in Uva for short periods previously. By mid-February, 1947 only five planting districts, Dumbara, Galle, Matara, Weligama and Moneragala, had not reported the disease. The disease was nowhere severe at elevations below 1,500 feet.

Reference may be made to the *Tea Quarterly* for 1947 for further details of the disease and the measures recommended for its control.

Very considerable assistance has been received in dealing with this disease, whose unexpected occurrence in Ceylon has thrown a heavy strain upon the resources of the division. Firstly, it is desired to acknowledge the help received from the Planters' Association, from District Planters' Associations, from individual superintendents far too numerous to mention by name, from Agency Houses and from commercial interests. Secondly, reference cannot be omitted to the help received, in one way or another, from the staff of every other division of the Institute.

F. R. TUBBS,  
*Acting Mycologist.*

# REPORT

OF

## THE ENTOMOLOGIST

FOR 1946

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**Advisory.**—406 letters were received and 461 despatched. 73 consignments of insects were received of which 54 related to tea. No insect pest was unduly prominent during the year.

**Publications.**—The following paper has been accepted for publication:—

Gadd, C. H.—Observations on the Life-Cycle of *Xyleborus fornicatus* Eich. in artificial culture. *Ann. App. Biol.* (Awaiting publication).

**Crotalaria Caterpillar.**—The food preference of the Crotalaria caterpillar *Argina argus* was demonstrated when a few species of Crotalarias were grown close together in a plot near the laboratory. *C. laburnifolia* was most severely attacked by this black and white, hairy caterpillar. *C. maxillaria* and *C. intermedia* were less heavily attacked while *C. anagyroides* was left alone. The caterpillars refused to feed on *C. anagyroides* even when other Crotalaria leaves were not available.

The life cycle of *Argina argus* at St. Coombs occupies about 51 days, divided into the following stages, Egg, 7-9 days, Larva (5 instars) 25-28 days, Prepupa 2-3 days and Pupa 12-15 days. The female lays 60 to 70 eggs but unless fertilised they do not hatch. The eggs are laid in groups on the underside of the leaves and the larvae go into the soil to pupate.

**Cutworms.**—The common cutworm at St. Coombs is *Agrotis (Euxoa) segetum*, Schiff. It is the well known black caterpillar which comes to the soil surface at night to feed and then cuts down young plants at ground level. Its life cycle when fed on cabbage leaves at St. Coombs occupied about 10 weeks divided into the following stages: Egg 5-6 days, Larva 37-41 days (6 instars) Prepupa 2-4 days and Pupa 17-24 days. The female lays about 1,000 eggs, 3 or 4 days after becoming adult. The egg counts of 3 females varied from 812 to 1,149.

**Cutworm Predator.**—In March two small shining black beetles with markedly flattened bodies were observed struggling with a full grown cutworm which was ultimately killed and devoured. The beetles proved to be *Hister pteromalus*, a fairly common species at St. Coombs. These beetles, and others collected later, were kept in the laboratory for further observations. They were easily maintained in small jars containing damp soil so long as they were frequently supplied with cutworms, white grubs (Cockchafer larvae), leather jackets (Crane-fly larvae) and similar soil insects.

For their size (they measured 11 mm in length) they killed a surprisingly large number of insects. The two originally observed were still alive at the end of the year and had then killed and consumed 95 large insect larvae. Another specimen devoured 66 in 115 days.

Eggs were laid at the bottom of the jars but were never numerous. The best performance was by one beetle which laid 12 eggs over a period of two months, one at a time at irregular intervals. The eggs are large, measuring 4 by 2mm. and hatch in 14-17 days at room temperature or in 9-12 days in an incubator at 25°C.

The young larvae have large mandibles and appear well equipped to hold and kill insect larvae, but in captivity they are sluggish and make no attempt to kill for food. Deaths amongst them began to occur after 8 days no matter what was offered as food. It seems probable, however, that insect larvae are their normal food as they could feed on the fluid exuding from wounded insect larvae or earthworms. One was kept alive in this manner for as long as 43 days and on a few occasions it attacked fly maggots and small earthworms, but so far all attempts to maintain this insect through its larval stage in captivity have failed.

*Paniscus laevis*.—In May and September when searching soil for cutworms small brown cocoons were found and they proved to be the cocoons of *Paniscus laevis*. This Ichneumon parasite as mentioned in my report for 1943 periodically occurs in large numbers but its host remains unknown. Numerous cutworms collected from soil have been maintained in the laboratory but only one proved to be parasitised by *P. laevis*. Although that observation indicates cutworm (*Euxoa segetum*) to be a host the low percentage parasitised leaves doubt that it is the main host of the parasite. The parasites normally do not mate in captivity and in laboratory experiments only one cutworm was parasitised. The larval stage, including the incubation of the egg, occupied 14 days and the pupal stage 18 days. The adults live for 4 or 5 weeks.

### SHOT-HOLE BORER

**Life-Cycle.**—For the first time the shot-hole borer beetle (*Xyleborus fornicatus*) has been reared from egg to adult outside its own galleries this year. No difficulty was experienced with the egg and pupal stages as they can be carried through on damp blotting paper. The larvae or feeding stage offered the greatest difficulty. It has long been known that the larvae feed on a fungus which grows on the gallery walls and is generally termed Ambrosia fungus. This particular fungus named *Monacrosporium ambrosium* was isolated from the gallery walls and grown in pure culture on suitable medium in tubes. Larvae when transferred from their galleries to the tubes immediately began to feed on the fungus. Larvae from newly hatched eggs behaved similarly for the first few days until they were due to moult for the first time. At this stage deaths were numerous but when past the first moult they usually thrived until full grown when they pupated.

Temperature has a marked effect on the length of the various stages, particularly the larval stage. At room temperature (15-25°C) at St. Coombs (4,500 feet), deaths amongst larvae were very numerous and the mean larval period was 23.6 days, whereas in an incubator at 28°C the period was only 12.4 days. This fact is of particular interest as it affords an



explanation of the distribution of the pest. St. Coombs is just above the beetle's upper distribution limit and although a few galleries sometimes occur in the bushes living beetles are rarely found in them. It therefore becomes evident that the lower mean temperature prevents the establishment of the beetle at the higher altitudes and that the beetle is unlikely to extend its range in that direction.

These experiments are of particular interest because they afforded a means of testing by direct observations conclusions obtained by indirect methods concerning the life cycle of this insect. At temperatures giving an incubation (egg) period of 7 days, the larval period is 15 days and the pupal stage occupies 7 days giving fair agreement with previous conclusions. Measurements of the widths of larval head capsules had indicated that the larvae moult three times. It is now known that at 28°C the first moult may occur after 2 days, the second after 6 days and the third after 10 days. These, however, are minimum periods, the average being somewhat longer.

Although the eggs are usually found in small groups it is now known that the female rarely lays as many as 3 eggs in a day. More usually she lays only one per day.

When the beetles leave the galleries they are black but when newly emerged from the pupal cases they are yellow. The colour change takes at least 5 or 6 days, a much longer period than previously had been assumed. They must remain in the galleries for that period at least before emerging, and that fact affords a simple explanation of the accumulation of young adults often found in galleries.

Mating has not been observed nor have beetles raised in culture been induced to lay eggs. Mating is said to occur within the galleries and there is some evidence to support that observation. But it also seems very probable that many females leave the galleries without being fertilised. If they then make galleries, as many probably do, they are unable to raise a family.

**Branch Breakages.**—Weekly collections of broken branches from the Passara experimental plots were continued till September when the bushes were pruned at the end of a 3-year cycle. The weekly average for each month is given in Table 1, together with the numbers collected in 1942, the corresponding year of the previous cycle. It will be noted that the number of broken branches steadily diminished through the year as had occurred in 1943, the third year of the previous cycle, and that relatively little damage was done.

In my last annual report attention was drawn to the fact that Shot-hole borer damage was much less in 1945 than in 1942. As may be seen from Table I, the damage in 1946 was also less than that in 1943. Evidently the borer attack during the cycle 1943-46 was much less than that in the earlier cycle, 1940-43. No definite reason can be given for that decrease in damage though the following observations may be suggestive. The pruning in 1940 was done at the end of a 2-year cycle, *i.e.*, when breakages were at a maximum and the beetle population large, whereas the 1943 prune coming at the end of the first three year cycle was done when breakages were at a minimum and the beetle population relatively small. In my last report I also commented on the absence of migration

TABLE I  
Average weekly breakages from 3·2 acres.

| Month         | Months<br>from<br>Pruning | 1946             |                                                  | 1943             |                                                  |
|---------------|---------------------------|------------------|--------------------------------------------------|------------------|--------------------------------------------------|
|               |                           | No. of<br>Plucks | Mean No.<br>broken<br>branches per<br>collection | No. of<br>Plucks | Mean No.<br>broken<br>branches per<br>collection |
| January ...   | 28                        | 5                | 355                                              | 4                | 405                                              |
| February ...  | 29                        | 4                | 307                                              | 4                | 266                                              |
| March ...     | 30                        | 4                | 272                                              | 4                | 246                                              |
| April ...     | 31                        | 4                | 182                                              | 5                | 271                                              |
| May ...       | 32                        | 5                | 116                                              | 4                | 231                                              |
| June ...      | 33                        | 4                | 142                                              | 4                | 262                                              |
| July ...      | 34                        | 5                | 118                                              | 5                | 282                                              |
| August ...    | 35                        | 4                | 126                                              | 4                | 283                                              |
| September ... | 36                        |                  | Pruned                                           |                  | Pruned                                           |

of beetles from heavily infested prunings to adjoining bushes at a suitable stage of growth for infection. It would appear therefore that the attack in any field will depend mainly upon the number of beetles present in that field when the bushes are pruned, the smaller the population the smaller the damage likely to occur during the next cycle.

**Survival After Pruning.**—When infested bushes are pruned a large number of galleries containing beetles are removed with the prunings. Most of the beetles in immature stages, and many adults, die as the branches dry out. Many galleries remain in the pruned bush but not all of them, even when the entrances are open, contain living beetles though some do. The question arises whether a pruned bush after a 3-year cycle offers satisfactory breeding sites for the beetle.

After the experimental area had been pruned in September five bushes in each of the 32 plots were selected at random for gallery counts. All galleries with open entrances were marked so that new galleries formed later could be recognised and counted. Counts were made at fortnightly intervals over a period of 10 weeks. After the first count half the bushes were sprayed with Gammexane or Gesarol (D.D.T.), so the records summarised in Table 2 are shown under the headings, sprayed and control.

It will be seen from the table that the number of new galleries decreased in successive fortnightly periods and that in this respect the sprayed and control bushes gave similar results. As there were more galleries in the control bushes initially it is necessary to express the results as percentages for purposes of comparison. It then becomes evident that new galleries were rather more numerous in the control plots but the difference is not sufficiently great to warrant the conclusion that spraying had a real effect in preventing new entries.

TABLE II

Record of new galleries formed in pruned (rim lung) bushes examined at fortnightly intervals from September 17th to November 26th, 1946.

| Treatment                    | Number of bushes | Number of Galleries Exam. | No. of new galleries formed |   |              |     |     |     |
|------------------------------|------------------|---------------------------|-----------------------------|---|--------------|-----|-----|-----|
|                              |                  |                           | 1                           | 2 | Examinations |     |     |     |
|                              |                  |                           |                             |   | 3            | 4   | 5   | 6   |
| Control                      | 80               | 1035                      | 106                         |   | 82           | 63  | 43  | 41  |
| Sprayed                      | 80               | 592                       | 40                          |   | 30           | 18  | 14  | 10  |
| New galleries as percentages |                  |                           |                             |   |              |     |     |     |
| Control                      | 80               | 100                       | 10.2                        |   | 7.9          | 6.1 | 4.1 | 4.0 |
| Sprayed                      | 80               | 100                       | 6.8                         |   | 5.1          | 3.2 | 2.4 | 1.7 |

The new galleries are made by young females in order to raise families in them. The counts of new galleries are, therefore, counts of potential mothers. Allowing that the average size of the family remains constant, the increase of a population will depend upon an increase of the number of mothers. If in successive intervals increasing numbers of females undertake parenthood, the population would steadily increase in number so long as the death rate remained constant. A regular decrease in the number of potential mothers must result in a fall in the population numbers and if the decrease persists it may result in extinction. The observations recorded in Table 2 indicate clearly a steady and regular decrease in the number of beetles producing families, from which we must conclude that pruned bushes are not a favourable medium for the beetles to breed in. After a time as new growth is formed conditions change and the beetle population begins to increase, as is shown by the damage measured as broken branches.

The bushes were rim lung pruned. At the first examination there were 1,627 galleries with open entrances of which 132 or 8 per cent were in the 'lungs.' During the 10 weeks of observation 447 new galleries were made of which 127 or 28 per cent were in the 'lungs.' The relatively high percentage of new galleries made on the lungs suggests that those branches are somewhat more attractive to the beetles than other parts of the bush. But even in those branches there was a decrease in the rate of formation of new galleries, indicating that they were by no means ideal for the beetle.

Although the evidence here offered suggests that the presence of 'lungs' may help borer beetles to survive the pruned period it would be very unwise to abandon that type of pruning in infested areas merely for that reason. 'Lungs' are left to aid the recovery of the bush from pruning, and that is of far more importance than the possible slight reduction in beetle population which might be achieved by their removal.

**Insecticides.**—Although insecticides have so far proved of no value in the control of shot-hole borer it seemed advisable to carry out tests with the new insecticides D.D.T. and Gammaxane because of their different



action. For preliminary experiments the bamboo borer *Dinodorus minutus*, which can easily be obtained in large numbers, was used. The results, however, were disappointing as the beetles had to be in contact with sprayed surfaces for more than 8 hours for the insecticides to have any appreciable effect. Trials with shot-hole borer beetles were equally disappointing particularly as borer beetles normally spend a very short time, a few hours at most, out of the galleries when they might come in contact with the insecticide.

In one experiment in which beetles emerging from a castor stump were supplied with cut tea stems, some of which carried the insecticide and others did not, the few beetles that made galleries in them showed a preference for the untreated branches. The experiment was by no means conclusive but it seemed desirable to test the matter further by a field trial. As already stated in an earlier section of this report one half the experimental area was sprayed and the other half kept as control. One block was sprayed with Gammexane (F. 530), another with Gesarol Spray (D.D.T.) both at the rate of 2 lbs. to 10 gallons water, on September 26th and again on December 13th, while two blocks were left unsprayed as controls. The amount of spray fluid used was 113 gallons per acre. Mention has already been made (Table 2) of the smaller number of new galleries observed in the sprayed blocks but the real test of efficiency will come later when the broken branches are counted.

**Legislation.**—The regulations made under the Plant Protection Ordinance, published in the Gazette of March 11th, 1932 were rescinded by an order published in the Gazette of August 2nd, 1946. This means that tea plants can now be removed from one estate to another *without* a permit from the Director of Agriculture. The removal of restriction will not increase the risk of spread of shot-hole borer. The beetle has long been established in all tea areas of Ceylon in which it can survive, and the introduction of a few beetles in planting material is not likely to alter that position. Clean healthy supplies should, however, always be used, but these may now be obtained from other estates or districts without the formality of a permit.

C. H. GADD.  
*Entomologist.*

# REPORT

OF

## THE AGRICULTURAL CHEMIST

FOR 1946

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**Staff.**—There were no changes in staff during the year. Attempts to recruit a senior officer to co-operate with this department in conducting investigations in soil physics relating to cultivation trials proved unsuccessful.

The Agricultural Chemist relinquished the Acting Superintendency of St. Coombs Estate on May 31st and took over the Organisership of Fertiliser Rationing on September 1st during the period of the Director's furlough. The division of time which these subsidiary duties required has allowed the prosecution of existing schemes of investigations with some modifications, but has not allowed the expansion of work to further projects.

**Advisory.**—Letters received 251. letters despatched 145.

**Carbon and Nitrogen Survey.**—In spite of some inevitable interruptions, the data for the carbon and nitrogen survey of the permanent experiments mentioned in the Report for 1945 have now been completed and await the opportunity for detailed examination. Cooper at Tocklai (Nitrogen supply in Tea, Memorandum No. 6) demonstrated that the continual incorporation of prunings from liberally manured tea increased the nitrogen content of the soil. He also inferred that the carbon content was similarly improved because, although he did not actually determine carbon contents, he found that the loss on ignition of soil from his nitrogen plots also appreciated over a period of years. Loss on ignition measures not only losses of carbonaceous material, but also of the elements of water in the mineral colloids of the soil. Assuming that this latter contribution is constant, his results support his contention though they do not give a precise quantitative expression to it. Cooper's experiment extended over 7 years. At the end of that time he showed that extra prunings produced by 40 lb. of nitrogen were contributing a significant amount of residual organic matter to the soil. To produce a significant increase in nitrogen content, differences of 80 lb. of added nitrogen were necessary.

The longest St. Coombs experiment on this subject totals 12 years but the nitrogen increments are limited to 40 lb. of nitrogen. Actual determinations of both carbon and nitrogen showed no increase that could be relied upon, although small positive differences were noted. Our rather different experiment confirms Cooper's findings that the use of artificial manures does not 'exhaust' the soil of either organic matter or nitrogen. This is in agreement with general considerations outlined elsewhere (Ele-

ments of Tropical Soil Science, p. 50). Inorganic nitrogen has no permanent existence in soil, but when linked with carbon its chances of survival are increased despite the fact that on occasions natural wastage can amount to nearly two tons of carbon and more than 400 lb. of associated nitrogen per acre per annum.

The top soil at St. Coombs is the typical black loam of up-country patnas overlying tropical red earth. It has a very high carbon content. The average values from three different experiments are given in Table I.

TABLE I

Carbon and Nitrogen Values for St. Coombs Soils.

| Age of tea              |     | Per cent |          | Ratio C. N. |
|-------------------------|-----|----------|----------|-------------|
|                         |     | Carbon   | Nitrogen |             |
| Old (possibly 50 years) | ... | 5.88     | 0.435    | 13.5        |
| Medium (20 years)       | ... | 6.92     | 0.437    | 15.8        |
| Young (13 years)        | ... | 7.03     | 0.404    | 17.4        |

The nitrogen value is also high and works out at more than 10,000 lb. per acre foot. This is especially mentioned here because in terms of the known fertility of our soils the figure looks fantastic, and it might be asked what use there is in supplying the small extra amount provided by artificial fertilizers. It has to be remembered, however, that only a very small portion of this soil nitrogen becomes available and at a very slow rate. Two other interesting points emerge from these results. The first is that the carbon content of the soil decreases with increased time of cultivation. As soon as agricultural operations begin on a virgin soil the rate of wastage increases enormously. It needs very special soil management such as is provided by rotations and leys in temperate agriculture to delay or prevent such deterioration. In the absence of a knowledge of the initial analyses of soil from these sites we cannot be absolutely sure of this time trend, but the data are consistent with findings elsewhere. That a secular change of importance is occurring is confirmed by the figures for C/N ratio. All these values are higher than the figure 10—12 usually quoted in the text books for the stable value assumed in mature agricultural soils. There are other examples in the literature which show that tropical soils do not invariably conform to the constants worked out from temperate examples. It will be a matter for further investigation to determine whether an increase in the period of cultivation is generally accompanied by a narrowing of the carbon-nitrogen ratio as is shown in these figures.

**Nitrogen Efficiencies.**—Wherever experimental work has been carried out on the nutritive requirements of tea, the general experience has been that an ample supply of nitrogen is the crop's prime manurial need, and that this element gives the largest response. As a result of continued trials the general picture of nitrogen response is beginning to emerge. The data are given in Table II, a, b and c, in the form of tabulated nitrogen efficiencies. The nitrogen efficiency is defined as the pounds of crop response given by a pound of applied nitrogen and is obtained by taking the crop yields at two levels of manuring and dividing their difference



by the difference in the nitrogen doses. It must not be confused with the ratio of total crop to nitrogen applied, which is much larger, since the total crop derives only partly from added manurial nitrogen. Since, as has been explained in previous publications, the response to nitrogen is linear, *i.e.*, strictly proportional to dose, it does not matter from what incremental differences the efficiency factor is calculated. In Table II a, the first two cycles had the factor calculated from  $N_{40}$  and  $N_0$  doses. Thereafter when all plots were augmented by 40 lb. of nitrogen, the relevant comparison became  $N_{80}$  and  $N_{40}$ .

The nitrogen was applied at time of pruning and at subsequent 12-monthly intervals. The increase in efficiency as the pruning cycle advances is now a familiar feature of our long-established experiment. As more foliage, and roots develop, better use can be made of the available nutrients. As an indication of this there are data from a field in its second year from pruning where half the plots were normally plucked, and the other half were stripped. The pruning cycle pattern was of the late maximum type and in the second year its nitrogen efficiency had not reached the maximum. For ordinary plucking the value was 1.63 but by the very severe treatment it was reduced to 0.92.

The highest nitrogen efficiency reached in any experiment is 6.4 which corresponds with the figure quoted by Carpenter (Empire Journal of Experimental Agriculture 1938 Vol. 6, pp. 1-10) but falls short of that in the U.P.A.S.I. experiments, (Annual Report of Tea Scientific Department 1945) where a figure of almost 9 is attained. This figure, however, is based on an arbitrary out-turn figure. The manurial treatments on the cultivation trial IIb, show a similar maximum, but on the longer pruning cycle this is not reached so early in the cycle.

The results from the Passara III c experiment need fuller explanation. This experiment was carried out for two cycles of two years' duration, on the basis of recording every third plucking round only. This proved unsatisfactory on two counts, first that the responses obtained were negligible and second that the accuracy of the experiment when conducted in that manner was below that of the continuously plucked experiments at St. Coombs. From the third cycle onwards the intermittent yield method was abandoned and the experiment was brought into line with the other manurial trials. This improved the accuracy but still failed to give significant responses. The third cycle nitrogen efficiencies are low but there were signs that right at the end of the second year distinguishable effects were beginning to appear. If low initial efficiencies were associated with the capacity to run on longer pruning cycles, as in the cultivation experiment, there was therefore an indication that this experiment might well be extended to a 3-year cycle. There were other cogent considerations. Dr. Gadd had shown that shot-hole borer breakage was at its peak in the second year and there was more than a probability that this damage was a contributory factor toward the lack of response to manures.

Accordingly the fourth cycle was extended to three years, with the result that shot-hole borer infestation remained low and a significant manurial response was shown in the third year, the first to appear in the nine years' duration of the experiment.

This result suggested a further modification of the experimental design. Considering that nitrogen efficiencies are always low in the first year, it was decided to utilize the 120 lb. of nitrogen given during the next cycle, not in three equal portions of 40 lb. per annum, but in increasing doses, so that more should be available when the condition of the bushes seemed likely to be particularly favourable for its efficient use. The doses given were 1st year nil, 2nd year 40 lb. Nitrogen as usual, 3rd year 80 lb.

The efficiency figures for the 5th cycle show that the modification was effective. The third year figure is calculated on the 80 lb. dose and gives a value slightly better than the second year, which is satisfactory as far as it goes. It is possible that 80 lb. was an excessive application, and if that were so, the apparent efficiency would be lower than the optimum. In the present cycle the doses applied will be 60 lb. in both years so as to clarify this point. It is of particular interest that the second year showed a significant response for the first time since the experiment was begun. Whether that was due to the lower degree of breakage which characterised the whole cycle, whose initial pruning took place at a time of minimal shot-hole borer infestation, must await further investigations. This experiment is of particular interest because it shows how six years of negative results were subsequently resolved to give data of particular interest and cogency through the valued co-operation of the Entomological Department.

TABLE II  
Nitrogen Efficiencies from Manurial Experiments.

(a)

N P K Factorial Experiment

| Cycle | Years   | 1st year | 2nd year | 3rd year |
|-------|---------|----------|----------|----------|
| 1     | 1930-33 | 0.6      | 3.7      | 4.0      |
| 2     | 1934-37 | 0.9      | 4.4      | 4.8      |
| 3     | 1937-40 | 0.8      | 2.9      | 2.8      |
| 4     | 1940-43 | 2.2**    | 6.2      | 6.4      |
| 5     | 1943-46 | 0.8      | 3.3*     | 6.0      |
|       | Mean    | 1.1      | 4.1      | 5.0      |

\*\* Early Tipping.

\* Drought.

(b)  
Cultivation and Weeding Experiment

| Cycle | Years   | 1st year | 2nd year | 3rd year | 4th year |
|-------|---------|----------|----------|----------|----------|
| 1     | 1936-39 | 0.8      | 0.8*     | 1.8*     | —        |
| 2     | 1939-43 | 0.2      | 1.5      | 3.6      | 6.2      |
| 3     | 1943-47 | 0.2      | 1.3      | 3.8      | 6.3      |

\* Young tea insufficiently mature to benefit by 80 lb. of Nitrogen per acre.

## (c)

## Passara Experiment.

| Cycle | Years   | 1st year  | 2nd year | 3rd year |
|-------|---------|-----------|----------|----------|
| 3     | 1938-40 | 0.6       | 1.8      | —        |
| 4     | 1940-43 | 0.8       | 1.9      | 2.5*     |
| 5     | 1943-46 | unmanured | 2.4*     | 2.7*     |

\* These years only gave significant yield responses.

**Potash Responses.**—During the first three cycles of the N.P.K. factorial experiment there was no response to potash that even nearly approached reliability. During the fourth cycle noticeable differences in yield between the potash plots were seen to develop. Over a cycle as a whole they were of doubtful validity, but in the last year there was no doubt that a potash effect had developed. This was confirmed in the fifth cycle when both  $K_{20}$  and  $K_{40}$  showed significant increases over  $K_0$ . Although  $K_{40}$  was somewhat superior to  $K_{20}$  the difference between them was not of assured validity, and the general conclusion that is warranted is that for the present, 20 lb. of potash per annum is adequately supplying the needs of the tea. This is about 5 lb. per annum less than the estimated quantity of potash that the cycle crop of 3500 lb. removed from the soil. Here then is a case of progressive depletion of soil potash, normally relatively abundant in Ceylon tea soils, which after eleven years reaches the critical point of deficiency. The results for 15 years are given in Table III. The advent of this deficiency has undoubtedly been hastened by the depredations of weeds (see p. 41 Annual Report for 1944, Bulletin No. 26).

During wartime the level of potash supply had been much less than the replacement needs of  $2\frac{1}{2}$  lb. of potash for every 100 lb. of crop removed. Furthermore, weeds have for various causes been particularly troublesome during the same period. It is possible therefore that although a general state of deficiency of potash is not likely, some estates may be suffering from an initial decline due to this cause.

TABLE III.

Potash Responses lb. per acre Yield.

|                           | 1st Cycle<br>1930-3 | 2nd Cycle<br>1934-7 | 3rd Cycle<br>1937-40 | 4th Cycle<br>1940-3 | 5th Cycle<br>1943-6 |
|---------------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| $K_0$                     | 2,142               | 1,853               | 1,609                | 2,321               | 3,180               |
| $K_{20}$                  | 2,094               | 1,829               | 1,638                | 2,371               | 3,422               |
| $K_{40}$                  | 2,148               | 1,833               | 1,648                | 2,438               | 3,517               |
| $P_{05}$                  |                     |                     |                      |                     |                     |
| Significant<br>difference | 113                 | 109                 | 98                   | 134                 | 141                 |

Some years ago the Tocklai Experiment Station published the results of an experiment on young tea, not in bearing, that showed very considerable growth response to heavy doses of potash (60 lb. per acre). Woodford and Cooper (Empire Journal of Experimental Agriculture 1941.



9, 12). In view of the general absence of response to potash on mature tea that had hitherto characterized Tocklai experiments as well as ours, this result was surprising, and no satisfactory explanation of this result has been adduced. The technique of the experiment seems adequately to guard against any systematic error. A newly laid out experiment on St. Coombs gave an opportunity to carry out an analogous trial. Tea planted in 1938 which had been slow in developing was cut across at 18 inches in 1946. Sample bushes were taken from plots receiving no potash and from others dressed with 60 lb. per acre. As with other experiments the prunings were dried and separated into leaf and wood. Table IV gives the dry weights.

TABLE IV.

Effect of Potash on Growth of Young Tea in lb. Total of Bushes.

|                   | Foliage Leaf | Wood | Total |
|-------------------|--------------|------|-------|
| $K_0$             | 182          | 96   | 278   |
| $K_{60}$          | 185          | 98   | 283   |
| Significant Diff. | 28           | 17   | 44    |

There is obviously here no evidence of response to potash in either foliage or wood. Dr. Woodford of Tocklai in a private communication has suggested that weed competition which, as reported in the Annual Report for 1944 (p. 41), is responsible for removal of much potash, may affect young tea before its root range is sufficiently developed to fend adequately for itself. Under Indian conditions weed cover is general over large parts of the year. The layout of this experiment includes various systems of weed control and it will be possible to obtain further information on this question as the experiment proceeds.

T. EDEN,

*Agricultural Chemist*

# REPORT

OF

## THE PLANT PHYSIOLOGIST

FOR 1946

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**Staff.**—Acting charge of the Mycology Division was assumed, in addition, to normal duties, on the 15th September when Dr. Gadd took over the duties of Acting Director. The arrival of blister blight in Ceylon shortly afterwards necessitated very considerable time being spent on advisory and other work connected with the disease, and it is now apparent that the expansion of the work of the Physiology Department planned subsequently to return from military service will be most seriously impeded by the diversion of staff from the department to supplement the resources of the Mycology Department in dealing with the disease. The inevitable effect upon the progress of the lines of research allotted to the Department is a matter for considerable regret, but must be accepted.

Assistant staff, reduced by transfer to other departments at the beginning of the war, was still further reduced by illness during the greater part of the year. It now appears unlikely that the anticipated increase in staff in 1947 will, in fact, be possible.

**Advisory.**—287 letters were received and 275 despatched.

**Publications.**—The following paper was prepared and accepted for publication :—

“The Effect of Cultivation on the Growth of Young Tea.”—*Empire Journal of Experimental Agriculture*.

### TEA SEED.

**Yields.**—The collection of seed from Khorijan bearers was continued, a further twenty eight trees coming into bearing during the year. The data to-date are shown in Table I.

The percentage of empty seed (Table II) fluctuated less markedly than usual during the year. (See Annual Report for 1945). Small seed was least frequent during the period September-December, during which months the crop harvested amounted to 69.6 per cent of the crop for the year.

It is necessary to modify the statement (Annual Report 1944) that the major cropping months are May to August, as data for subsequent years have shown considerable variation (Table III).

TABLE I  
Yields from Seed-Bearers.

| Year | No. of Bearers | Year First Bearing | S E E D |                  |                   |                  |
|------|----------------|--------------------|---------|------------------|-------------------|------------------|
|      |                |                    | Total   | Sinkers per cent | Floaters per cent | Empties per cent |
| 1942 | 11             | 1942               | 2 230   | 57               | 25                | 18               |
| 1943 | 12             | 1942-3             | 2,243   | 60               | 25                | 15               |
| 1944 | 14             | 1942-4             | 2,128   | 49               | 33                | 18               |
| 1945 | { 14           | 1942-4             | 8,938   | 47               | 39                | 15               |
|      | { 16           | 1945               | 1,057   |                  |                   |                  |
| 1946 | { 14           | 1942-4             | }       | 52               | 30                | 19               |
|      | { 16           | 1945               |         |                  |                   |                  |
|      | { 28           | 1946               |         |                  |                   |                  |

TABLE II  
Percentage of Empty Seed

| Jan. | Feb. | Mar   | April | May  | June |
|------|------|-------|-------|------|------|
| 11   | 10   | 22    | 28    | 26   | 18   |
| July | Aug. | Sept. | Oct.  | Nov. | Dec. |
| 23   | 19   | 25    | 23    | 11   | 17   |

TABLE III  
Percentage Crop Harvested Monthly

| Year | Jan. | Feb. | March | April | May  | June |
|------|------|------|-------|-------|------|------|
| 1944 | 6.7  | 3.5  | 2.3   | 3.5   | 4.4  | 15.8 |
| 1945 | 2.6  | 5.0  | 5.2   | 8.0   | 5.6  | 10.0 |
| 1946 | 6.8  | 4.5  | 3.0   | 1.5   | 2.3  | 2.4  |
| Year | July | Aug. | Sept. | Oct.  | Nov. | Dec. |
| 1944 | 21.4 | 7.1  | 5.4   | 10.1  | 8.0  | 11.8 |
| 1945 | 9.0  | 10.1 | 10.1  | 10.8  | 13.2 | 10.4 |
| 1946 | 4.5  | 5.3  | 15.8  | 20.3  | 21.0 | 12.4 |

A common trouble in old established seed bearer areas where manuring has been spasmodic or ill-balanced in the past, and where green manure or humus is rarely added to the soil, is a dieback of a proportion of the



terminal shoots accompanied by loss of leaf area, due apparently to failure to replace ageing leaf surface. New extension growth may continue on some of the leaders, only to die back in turn. The condition is remediable by improving the fertility of the area.

An illustration is provided by the case of a bush grown from a multi-embryo seed which was planted near the laboratory in a small prepared hole in otherwise very infertile "soil" on a cut site. During the war years little growth was made and in 1946 the bush was only seven feet high, while symptoms similar to those described were very marked. Injection of a dilute solution of urea (0.25%) and potassium hydrogen phosphate (0.25%) was carried out until necrotic symptoms appeared in the vicinity of the injections, in order to increase the nutrient status of the bush. Six weeks later, active growth commenced and green manures and cattle bulk were then forked in around the bush. In the subsequent year, it grew four feet in height and is now entirely healthy, save for a vertical injury on the main stem where injection was carried to excess.

The symptoms described may be related to those observable in those areas of 'thin bushes' which are becoming apparent on estates where the drain on nutrient elements by cropping has for some years exceeded replacement, owing to fertiliser rationing.

### CLONES.

**1937-8 Clones.**—The yields per acre and order of merit of these clones are shown in Table IV for a further complete period of 40 pluckings (1 year). Clone 25 was again rested for the production of material for propagation.

TABLE IV  
Yields of 1937/8 Clones  
From 9th April, 1945 to 26th March, 1946.

| Clone     | Number of Bushes | Calculated Yield per acre (lbs.) | Order of Merit |
|-----------|------------------|----------------------------------|----------------|
| 1         | 22               | 535                              | 8              |
| 9         | 22               | 825                              | 3              |
| 13        | 28               | 430                              | 11             |
| 14        | 19               | 445                              | 9              |
| 15        | 25               | 675                              | 6              |
| 6         | 21               | 445                              | 9              |
| 18        | 28               | 745                              | 5              |
| 19        | 21               | 395                              | 12             |
| 21        | 21               | 790                              | 4              |
| 222       | 26               | 875                              | 2              |
| 23        | 23               | 1155                             | 1              |
| 25        | —                | —                                | —              |
| Seedlings | 24               | 675                              | 6              |

**1939 Clones.**—These clones were pruned in 1945. The yields per acre per annum, based on 40 pluckings during 1946-47, are shown in Table V, together with the relative order of merit for the period,

TABLE V  
Yields of 1939 Clones  
From 4th April, 1946 to 20th March, 1947.

| Clone | No. of Bushes | Calculated Yield per acre (lbs.) | Order of Merit |
|-------|---------------|----------------------------------|----------------|
| 4     | 22            | 860                              | 3              |
| 32    | 13            | 510                              | 5              |
| 33    | 20            | 460                              | 6              |
| 37    | 15            | 1305                             | 1              |
| 45    | 20            | 1205                             | 2              |
| 46    | 20            | 840                              | 4              |

**1941 Clones.**—The yields of the clones planted out in 1941 are shown in Table VI. The yields of duplicate rows, where such exist, are included.

TABLE VI  
Yields of 1941 Clones.  
From 18th February, 1946 to 4th February, 1947.

| Clone | Number of Bushes | Calculated Yield per acre (lbs.) | Order of Merit |
|-------|------------------|----------------------------------|----------------|
| 216   | 21               | 825                              | 6              |
| 331   | 22               | 925                              | 4              |
| 928   | 18               | 1170                             | 2              |
| 1082  | 20               | 925                              | 4              |
| 1114  | 18               | 1635                             | 1              |
| 1294  | 22               | 810                              | 7              |
| 1526  | 21               | 1040                             | 3              |

These clones have now been plucked on 120 occasions (3 years) and the yields to-date indicate that the method of selection originally adopted, *i.e.*, selection in old fields, has resulted in clones of a long cycle type whose yields three-and-a-half years from pruning are very satisfactory. The mean yields in each of the three years of plucking are 389 lb., 636 lb. and 1,047 lb. Clone 1,114 provides the most striking individual example, having given yields of 415 lb., 825 lb. and 1,635 lb. Such types will be of added value should blister blight necessitate longer cycles being generally adopted. It may here be noted that these clones received no special manuring, an annual application of 40 lb. nitrogen being applied.

**1941-42 Clones.**—These eight clones were planted in rows among older tea and are therefore considered as a separate group (see Table VII), owing to the serious competition suffered during the establishment period.

**1943 Clones.**—Seventeen of these clones were brought into plucking. Five clones remain, of which two will be brought into plucking in 1947. The remaining three will be discarded and replaced with rows of clones 25, 3 and 23.

**1944 Clones.**—Eight of the 12 clones will be brought into plucking in 1947, Sirikandura 255, Sirikandura 223, 789, 1,544, Nayabedde 1, Nayabedde 3 and 1,002. Sirikandura 173 will be replaced with a duplicate row of 1,114 in 1947.

**Clonal Pruning Programme.**—In order to make records as fully comparable as possible, and to provide accurate information on the behaviour of clones during different portions of the cycle, it was decided to revert to the original plan of pruning one-third of each multiplication plot in each year. In view of the difficulty of ensuring uniformity from year to year in the stage of growth at which such operations as tipping take place, cultural operations in 1946 were placed on a calendar basis, which will be adhered to for the next two years.

|                                      |                                                         |
|--------------------------------------|---------------------------------------------------------|
| Centring young plants                | <i>Circa</i> May 15th.                                  |
| Cutting across prior to 1st plucking | <i>Circa</i> May 15th.                                  |
| Pruning of old tea                   | <i>Circa</i> May 15th.                                  |
| First tipping, young and old tea     | <i>Circa</i> July 15th.                                 |
| Second tipping, young and old tea    | <i>Circa</i> August 7th.                                |
| Third tipping, young and old tea     | <i>Circa</i> August 28th.                               |
| First plucking, young and old tea    | on 41st plucking of series<br>pruned the previous year. |

In Table VII the yields of each clone during the first six months of plucking in the new cycle are shown, together with the information available from the extensive series of manufactures carried out by the Bio-chemist during the last eight years. The data include results up to 21st February, 1947 inclusive. It is emphasised that this information provides a general basis for comparison only.

Attention is again drawn to the marked, and consistent, differences in the teas made from different clones.

**Selection.**—During the year forty-nine additional mother bushes were selected and propagated for test of rooting capacity, prior to selection of the best rooters for planting in multiplication plots for further test. This series is designed to extend the range of selections at St. Coombs to include more plants of the 'Assam' type. The early selections were necessarily from fields of 'mixed hybrid' or 'hybrid' types showing obvious 'China' influence.

Two additional clones from outside estates were received for propagation and test at St. Coombs.

In all some 20,248 cuttings have been put during the year, including all old clones, irrespective of rooting capacity. From these 8,235 plants have been obtained (40.7%), the best rooting clone giving 98.1 per cent success, and the poorest 0.0 per cent.

**Planting.**—An experiment was commenced in 1946 designed to provide further information upon (a) the possibility of direct planting of cuttings in the field and (b) the characteristics of the 25 best clones available at St. Coombs. The layout consisted of a balanced lattice square. This was chosen as giving comparisons of equal accuracy between all varieties, and as allowing the experiment to be split into two halves, with slight loss of accuracy, should future work require it. The 'red-flush' clone, number 26, was used as guard rows between each of the six groupings,



TABLE VII

Yields (New Series) and Manufacture Results (all clones in plucking.)

From 14th September, 1946 to 3rd March, 1947.

| Clonal Series | No. of Bushes Plucked | Calculated Yields per acre | Order of merit (Yield) | Manufacture     |               |         |               |
|---------------|-----------------------|----------------------------|------------------------|-----------------|---------------|---------|---------------|
|               |                       |                            |                        | Number of Tests | Above Average | Average | Below Average |
| 1937/8        |                       |                            |                        |                 |               |         |               |
| 1             | 11                    | 240                        | 8                      | 4               | 1             | 2       | 1             |
| 9             | 6                     | 325                        | 5                      |                 |               |         |               |
| 13            | 10                    | 170                        | 13                     | 3               | 0             | 1       | 2             |
| 14            | 9                     | 190                        | 11                     | 4               | 4             | 0       | 0             |
| 15            | 10                    | 315                        | 6                      | 3               | 3             | 0       | 0             |
| 16            | 9                     | 190                        | 11                     | 4               | 4             | 0       | 0             |
| 18            | 10                    | 305                        | 7                      | 3               | 1             | 2       | 0             |
| 19            | 10                    | 215                        | 9                      | 3               | 1             | 1       | 1             |
| 21            | 8                     | 355                        | 4                      | 9               | 6             | 3       | 0             |
| 222           | 9                     | 380                        | 3                      | 3               | 2             | 1       | 0             |
| 23            | 9                     | 390                        | 2                      | 11              | 9             | 1       | 1             |
| 25            | 9                     | 395                        | 1                      | 4               | 3             | 1       | 0             |
| Seedlings     | 9                     | 215                        | 9                      | 8               | 4             | 2       | 2             |
| 1939          |                       |                            |                        |                 |               |         |               |
| 4             | 10                    | 310                        | 4                      | 5               | 3             | 1       | 1             |
| 32            | 9                     | 135                        | 6                      | 4               | 2             | 0       | 2             |
| 33            | 12                    | 185                        | 5                      | 4               | 2             | 1       | 1             |
| 37            | 8                     | 405                        | 2                      | 11              | 4             | 3       | 4             |
| 45            | 9                     | 455                        | 1                      | 11              | 4             | 7       | 0             |
| 46            | 11                    | 395                        | 3                      | 11              | 2             | 4       | 5             |
| 1941          |                       |                            |                        |                 |               |         |               |
| 20            | 2                     | 75                         | 36                     | 9               | 0             | 3       | 6             |
| 22            | 11                    | 250                        | 15                     | 13              | 1             | 2       | 10            |
| 34            | 7                     | 190                        | 27                     | 11              | 1             | 7       | 3             |
| 43            | 11                    | 225                        | 20                     | 7               | 2             | 4       | 1             |
| 43            | 8                     | 160                        | 30                     | {               |               |         |               |
| 128           | 10                    | 250                        | 15                     |                 | 5             | 6       | 2             |
| 216           | 11                    | 255                        | 14                     | {               | 9             | 1       | 1             |
| 216           | 12                    | 210                        | 23                     |                 |               |         |               |
| 331           | 12                    | 230                        | 18                     | {               | 5             | 3       | 0             |
| 331           | 11                    | 165                        | 29                     |                 |               |         |               |
| 343           | 10                    | 210                        | 23                     | 13              | 2             | 6       | 5             |
| 397           | 11                    | 115                        | 35                     | 12              | 2             | 6       | 4             |
| 407           | 11                    | 225                        | 20                     | 16              | 1             | 2       | 8             |
| 483           | 10                    | 135                        | 32                     | 13              | 3             | 10      | 0             |
| 510           | 10                    | 230                        | 18                     | 11              | 2             | 4       | 5             |
| 603           | 11                    | 330                        | 6                      | 12              | 0             | 4       | 8             |
| 777           | 11                    | 430                        | 1                      | {               |               |         |               |
| 777           | 11                    | 330                        | 6                      |                 | 3             | 7       | 3             |
| 839           | 12                    | 210                        | 23                     | 12              | 2             | 5       | 5             |
| 928           | 9                     | 210                        | 23                     | 11              | 7             | 4       | 0             |
| 934           | 10                    | 330                        | 6                      | 3               | 1             | 2       | 0             |
| 960           | 1                     | 135                        | 32                     | 11              | 0             | 1       | 10            |

TABLE VII—(Contd.)

| Clonal Series | No. of Bushes Plucked | Calculated Yield per acre | Order of merit (Yield) | Manufacture     |               |         |               |
|---------------|-----------------------|---------------------------|------------------------|-----------------|---------------|---------|---------------|
|               |                       |                           |                        | Number of Tests | Above Average | Average | Below Average |
| 1005          | 9                     | 215                       | 22                     | 12              | 2             | 8       | 1             |
| 1016          | 8                     | 185                       | 28                     | { 13            | 5             | 5       | 3             |
| 1016          | 9                     | 150                       | 31                     |                 |               |         |               |
| 1076          | 12                    | 265                       | 13                     | 13              | 3             | 8       | 2             |
| 1082          | 11                    | 365                       | 4                      | 5               | 4             | 1       | 0             |
| 1114          | 10                    | 305                       | 10                     | 11              | 1             | 2       | 8             |
| 1294          | 12                    | 420                       | 2                      | { 33            | 31            | 2       | 0             |
| 1294          | 11                    | 325                       | 9                      |                 |               |         |               |
| 1526          | 10                    | 305                       | 10                     | { 10            | 7             | 3       | 0             |
| 1526          | 10                    | 380                       | 3                      |                 |               |         |               |
| 1530          | 11                    | 350                       | 5                      | { 13            | 7             | 5       | 1             |
| 1530          | 10                    | 280                       | 12                     |                 |               |         |               |
| Seedlings     | 11                    | 250                       | 15                     | { 14            | 1             | 5       | 8             |
| Seedlings     | 10                    | 135                       | 32                     |                 |               |         |               |
| 1941/42       |                       |                           |                        |                 |               |         |               |
| 105           | 6                     | 160                       | 3                      | 8               | 3             | 2       | 3             |
| 142           | 10                    | 175                       | 2                      | 8               | 1             | 4       | 3             |
| 293           | 8                     | 140                       | 4                      | 6               | 1             | 3       | 2             |
| 396           | 5                     | 100                       | 5                      | 8               | 0             | 3       | 5             |
| 687           | 4                     | 35                        | 8                      | 2               | 0             | 2       | 0             |
| 740           | 7                     | 200                       | 1                      | 8               | 2             | 4       | 2             |
| 862           | 9                     | 100                       | 5                      | 8               | 2             | 2       | 4             |
| 999           | 7                     | 100                       | 5                      | 8               | 5             | 1       | 2             |
| 1943          |                       |                           |                        |                 |               |         |               |
| 170           | 25                    | 135                       | 8                      | 6               | 3             | 2       | 1             |
| 235           | 26                    | 125                       | 10                     | 6               | 5             | 1       | 0             |
| 384           | 21                    | 110                       | 13                     | 7               | 0             | 4       | 3             |
| 425           | 29                    | 150                       | 5                      | 6               | 4             | 2       | 0             |
| 708           | 28                    | 100                       | 14                     | 6               | 0             | 2       | 4             |
| 742           | 26                    | 65                        | 16                     | 6               | 0             | 1       | 5             |
| 896           | 24                    | 125                       | 10                     | 6               | 0             | 2       | 4             |
| 946           | 29                    | 140                       | 6                      | 7               | 1             | 1       | 5             |
| 997           | 25                    | 125                       | 10                     | 6               | 2             | 4       | 0             |
| 1000          | 29                    | 85                        | 15                     | 6               | 6             | 0       | 0             |
| 1001          | 9                     | 190                       | 3                      | 6               | 4             | 1       | 1             |
| 1054          | 30                    | 165                       | 4                      | 7               | 1             | 4       | 2             |
| 1118          | 10                    | 135                       | 8                      | 7               | 1             | 2       | 4             |
| 1128          | 20                    | 240                       | 1                      | 7               | 2             | 4       | 1             |
| 1387          | 12                    | 60                        | 17                     | 6               | 4             | 2       | 0             |
| 1446          | 16                    | 200                       | 2                      | 6               | 1             | 2       | 3             |
| 1456          | 24                    | 140                       | 6                      | 7               | 2             | 5       | 0             |

(Taints of unknown origin were found in teas from Clone 407 on two occasions and in 934 on one occasion, additional to the above.)

Data are being collected upon the survival and growth of the cuttings, and vacancies will be supplied in 1947 from nursery-rooted cuttings. Interesting variations in the ability of cuttings of different clones to survive the harsher conditions obtaining in the open have already been noted. Blister blight, white grub, drought and especially the unavoidably late start (mid-September) have combined to make the test a severe one. It is anticipated that a considerable proportion may perish during the January-March dry weather owing to the root systems being still too small.

(Note.—The experiment was later abandoned and a new start was made in May, 1947, thereby allowing the cuttings a more reasonable rooting period).

**Supplying in Multiplication Plots.**—Since interest in the data from multiplication plots is concentrated in the relative behaviour of different clones, and not on absolute yields, there should be little temptation to 'coddle' the plants. But in work with scarce material it is often of importance to ensure that vacancies are replaced with healthy plants with as little check to growth as possible in order that multiplication material may quickly be made available. Transplanters provide a means of achieving this with small plants, but experience has shown it to be inadvisable to transplant cuttings of less than a year's growth under the conditions obtaining at St. Coombs. With larger plants, up to four years old, very promising results have been obtained by applying Roach's injection technique during the establishment period. Tubes of water were connected by short lengths of rubber tubing to the cut end of lateral branches, avoiding air bubbles. Fresh cuts were made twice a week, about one quarter of an inch being removed. In spite of the fact that transplanting took place in March and April, during a period of fine weather which might well have resulted in 100% casualties, only 5% died. Each of the deaths was due to continuing the injection for too long a period and thereby waterlogging the plant tissues. All these casualties were in one clone, which may be abnormally sensitive. An injection of 0.25% urea plus 0.25%  $\text{KH}_2\text{PO}_4$  was given in the last week of treatment, i.e., when active growth was just starting. The subsequent growth was abnormally good; shoots 18-in. long were produced four months after transplanting on 4-year-old stumps. A similar technique was used, with satisfactory results, to stimulate growth on a seed-bearer growing in very poor soil in a cut site.

It is necessary to reduce the number of leaves on the transplant to three or four if this technique is used in dry weather unless the size of the water container is considerably enhanced and injection tubes are fitted at several points. In rainy weather, the method permits of evergreens being transplanted in full foliage. A large bush of *Brunfelsia hopeana* continued to flower profusely in spite of being moved in this manner, nor did any leaf-fall occur.

The method has no large-scale application in tea, but may be useful where material is short, where it is desired to re-establish a complete stand of mature bushes or trees without delay, or in transplanting specially selected bushes from the fields in which they were selected in order to form a seed-bearer area. It is essential to shade the tubes and container from over-heating by the sun.



### CULTIVATION AND GROWTH OF YOUNG TEA.

An investigation upon the establishment of young tea commenced in 1938, and subsequently interrupted by the writer's absence on military service, has since yielded results confirming and extending those already recorded by Dr. Eden from established tea. The investigation was designed to compare the effect of different types of cultivation upon the establishment and growth of two-year-old seedling 'stumps' in soil from which established tea had been uprooted. The details of the treatments applied are as follows:—

- (a) *Holing*.—Holes were cut two feet apart. They were 18 inches deep and 12 inches wide, tapering to 9 inches wide at the bottom and were refilled with the soil removed. No disturbance of the soil between the holes in a line took place, save that caused during the removal of the original bushes.
- (b) *Trenching*.—A continuous trench was cut 18 inches deep and 12 inches wide, the length of the line and the soil subsequently returned, some mixing taking place in the process.
- (c) *Forking*.—Very thorough 'envelope' forking with 16-inch forks was carried out in strips 12 inches wide along the length of the plot line, the fork being inserted to its full depth.

The area was planted along the cultivated lines with 'stumps' consisting of taproot and six inches of stem only, all laterals being removed. Cultivation, subsequent to planting, consisted in periodic 'envelope' forking of alternate 'rows,' (*i.e.*, areas between pairs of lines), accompanied by the incorporation of green manures and artificials.

To determine the residual effects upon the soil eight years later (1946) of the three treatments, five determinations of the resistance to the movement of a probe through the soil were made in each line, the sites being midway between pairs, chosen at random, of bushes planted in 1938. The data for 'Holing' therefore referred to soil which had been undisturbed save for the pre-1938 cultivation of the area, and the uprooting of the original bushes, while those for 'Trenching' were equally applicable to the soil in the 'Holes' in which the bushes in the 'Holed' plots commenced their growth.

In the first three inches consolidation was low and did not vary with treatment. Below this depth, the extent to which the trenched soil had retained its looser structure over the intervening eight years was most striking. The lesser degree of soil disturbance at depths greater than about 7 inches resulting from forking was also still discernible; the resistance of the forked soil was significantly greater than that of the trenched soil at depths over 7 inches, and less than that of untreated soil ('Holing') to a depth of 10 inches only. This is in accordance with Eden's results in which the resistance of forked soil to penetration was found to increase sharply at depths greater than 7 inches. It appears that under local conditions only one thorough disturbance is required to produce a lasting effect; and that the extra care required to obtain real efficiency in a single act of cultivation will achieve superior and more lasting results below the upper 4 inches than will repetitions of

less effective operations. The experiment provided a striking example of the permanence of the effects of a single thorough disturbance upon the structure of a tropical red-brown earth, the effects of which persisted for at least eight years under field conditions. It is clear that with soils exhibiting such stability of physical condition, frequent deep cultivations would serve no useful purpose.

The growth of the 'stumps' was followed by recording the stem diameter at the collar each April and October until 1941, followed by a final measurement in April 1946. Casualties were recorded as they occurred, and were replaced annually with plants which were excluded from the records. In April, 1946, the prunings from each plot were weighed fresh and an examination of the root systems carried out.

The existence of marked differences in the state of consolidation of the soil immediately surrounding the young plants was found to effect neither the percentage of plants establishing themselves nor their subsequent growth. The soil treatments had no significant effect upon the rate of increase in the stem diameter at ground level, either in the early years or over the total period of eight years. Similarly, no significant difference was found in the weight of prunings nor in the total fresh weight of the roots eight years after planting.

No significant differences in the maximum radius, or total weight, of the root systems were found. The only significant differences related to distribution of root growth and here again the smallness of the effect was remarkable. No significant difference, for example, was found in the distribution of roots in depth between the plants in the 'Holed' plots and those in the trenched plots, in spite of the considerable and continued difference in the state of consolidation of the surrounding soil. The distribution in depth of the major roots found in this experiment is in close accord with the distribution of feeding roots described by Eden and confirms his finding that cultivation, as such, has relatively little effect upon it.

It is hoped to republish the full account of this work in a forthcoming number of the *Tea Quarterly*.

**Bush Green Manures.**—A programme of selection, designed to obtain more vigorous strains of *Crotalaria anagyroides* and of *Tephrosia vogelii*, was commenced during the year. Branching habit, disease resistance and late flowering will also be taken into account.

F. R. TUBBS,  
*Plant Physiologist.*

# REPORT

OF

## THE BIOCHEMIST

FOR 1946

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**Staff.**—The Biochemist was on leave for the greater part of the year. Leave had been granted for nine months from the date of sailing (7th March, 1946), but a return passage from the United Kingdom was not available until 19th December, 1946.

During the absence of the Biochemist the Director took charge of the department and Mr. H. B. Sreerangachar supervised the laboratory. Later the Director also went on leave and the Agricultural Chemist assumed charge.

Mr. H. B. Sreerangachar was awarded the well-merited degree of Doctor of Science of the University of Bombay. This award is of special interest as the work on which the degree was awarded was carried out in the Biochemical Department and was concerned entirely with the biochemistry of tea manufacture.

**Correspondence.**—162 letters were received and 242 despatched. In addition the Biochemist attended to 110 letters whilst on leave.

**Lectures.**—The Biochemist addressed the Ceylon Association in London on 7th July. The address appeared in the *Tea Quarterly* published in December, 1946.

**Publications.**—Before going on leave, articles for the *Tea Quarterly* were prepared on the work carried out on Rolling and Direct Fired Heaters.

Dr. Sreerangachar also prepared a paper on "Further observations on tea fermentation and normal respiration" for publication in a scientific journal.

### BIOCHEMICAL

**The Chemistry of Tea Investigations in London.**—In 1937 when the Biochemist had settled down to work on tea manufacture and was concerned with long term plans, it was realised that the fundamental chemistry of tea involved problems and practical difficulties which would be extremely difficult to overcome with the facilities available in Ceylon.

On the other hand, an understanding of the nature of the principal chemical constituents of tea was essential as it was too optimistic to hope

that any real progress with the fundamentals of tea manufacture could be achieved without a knowledge of the main chemical changes taking place during manufacture.

Contacts with the staff of the Indian and Netherlands Research Stations revealed that similar difficulties were common to all tea research stations and eventually a joint scheme of investigation was organised and financed. It was decided that the investigation should be carried out in London and a Committee was appointed to direct the investigation.

It had been hoped that this work would begin with the investigation, of green leaf but, for various reasons, it became necessary to use made (black) tea as the starting point. This was unfortunate as work on green leaf would have linked up better with similar investigations in Ceylon.

To the complexities of working on manufactured leaf were added the difficulties of the war period. Dr. Bradfield, who has carried out these investigations, however adapted a most elegant modern technique of analysis to his requirements and has done some extremely interesting and most highly skilled and arduous work. War conditions eventually brought the investigation to a temporary halt and it was not possible to continue the investigation until the middle of this year.

A fresh start has been made, this time from green leaf, and progress has been extremely rapid. To a large extent Dr. Bradfield has broken the back of a problem which has proved intractable since scientific investigation of tea commenced. From the point of view of the Chemist and Analyst, the Biochemist and the Physiologist, Dr. Bradfield's work has driven new roads through territory which was previously a jungle in which it was only too easy to get lost.

In simple terms it is difficult to describe what Dr. Bradfield has achieved. Briefly, he has isolated and identified six compounds known as catechins belonging to a class of chemical compounds termed polyphenols (we have used the word polyphenol in recent years in preference to the word tannin). There are no true "tannins" in tea and the use of the word tannin in connection with tea has caused much confusion and misunderstanding. Ignorance of the chemical composition of tea has caused this confusion. Broadly speaking, the position is that the polyphenols are a large family, the tannins and the catechins being two different branches of the family. In a similar way the "Alkaloids" include both strychnine and morphine which are poles apart in their effects on the human body. Likewise the true tannins such as are used for tanning leather, and the powerful astringents used in medicine, are entirely different in nature from the catechin of tea.

Some of the catechins which Dr. Bradfield has isolated from tea are new variations hitherto unknown to chemists, and the isolation and identification of all these compounds in so short a time is a brilliant piece of research. The difficulties of the work were centred in the separation of so many chemically similar compounds which, although of different composition, behave similarly in chemical reactions. The particular method employed for the resolution is known as chromatographic analysis and has recently given immensely valuable results in the chemistry of wool.



The Biochemist had the much appreciated opportunity of meeting Dr. Bradfield in London and of seeing something of this new method of analysis. Co-ordination of our biochemical work with Dr. Bradfield's investigations will, it is hoped, yield further information on the problems of tea fermentation and possibly assist in later work on the nature of tea liquors from black tea.

In Ceylon we have learned a good deal about the enzyme responsible for oxidising these catechins. It now appears possible to study the action of the purified enzyme on purified catechins, one at a time, and to open an approach to the investigation of the chemical changes which these catechins undergo to form tea liquors.

We have already sent to London leaf from a number of clones of different quality and Dr. Bradfield is attempting to assess the relative amounts of the different catechins in these clones: there may be some relation between quality and specific catechins. All this work is highly academic at the moment, but technical developments depend largely on such fundamental work and the progress made by Dr. Bradfield is most encouraging and stimulating.

**Anthocyanins and Flavones.**—These coloured pigments are very closely related to the catechins. A particular bush with highly coloured flush was specially propagated by the Plant Physiologist to afford a sufficient quantity of the material for extraction of the pigment. So far attempts to isolate the pure pigment have not been successful.

#### ANALYTICAL.

One of the most difficult problems in this department has been to trace the effect of field conditions such as season, pruning cycle, etc. on the chemical composition of leaf arriving at the factory. It is evident that the quality of leaf does vary considerably and this, indeed, is generally supposed to have a greater effect on the quality of the tea manufactured than any normal variation of manufacturing technique. In spite of this apparently large variation of in the nature of the leaf it has proved to be most difficult to obtain any analysis of the factors involved.

The manufacture of individual bushes revealed such large differences between bushes that a very large sampling error was not surprising. It was hoped that when quantities of clonal leaf become available the problem would be simplified. However, we now find that there is a very large variation between the chemical composition of different pieces of flush picked from the same bush at the same time. It has previously been reported that different pieces of flush picked from the same bush at the same time show a wide variation in rate of wither (*vide* Annual Report for 1936).

With the close co-operation of the Plant Physiologist further samples were obtained this year from clonal rows, plucking at 1-day, 7-day and 14-day intervals. Daily plucking does of course ensure uniform "age" of flush with respect to the opening of the bud. Large variations were, however, still found in composition of flush from different bushes in the clonal rows. There was some evidence to suggest that the size of flush is related to this variation.

The investigation of sampling errors and technique has therefore been thoroughly explored and it now remains to evolve a suitable method of bulking samples to minimize the effect of these errors.

The effects of such factors as season, pruning cycle, sunshine, etc. upon chemical composition will have to be elucidated by statistical treatment of the analytical figures obtained from the carefully collected and bulked samples. The chances of obtaining significant results are, however, much higher now than they were before the sampling technique was studied.

### MANUFACTURE.

**Epicyclic Rolling.**—48 experiments representing 100 days' manufacture were carried out on this method of rolling which is regarded as one of great promise but which is full of pitfalls for the unwary.

It is important that clear objectives should be kept in sight in experiments of this nature. Our objective has been to exploit the possibilities of economy of labour and machinery without affecting the appearance of liquors of the tea made by this method of rolling.

The tea market is too conservative to react quickly to any large scale changes, and any new method of manufacture must maintain orthodox standards if it is to have an immediate general application. Where orthodox standards of product are required, the only advantage to be gained by new methods is therefore in the reduction of cost of production. Our experimental work is accordingly divided into two lines, one concerned with immediate application and the other with future developments.

This section of the report dealing with epicyclic rolling is regarded entirely from the point of view of immediate application, and the logical conclusion is that epicyclic rolling must be developed as a cheap method of imitating hand rolling. It may appear ludicrous but the bare facts are that rolling in a circular tea roller on battens is a mechanised version of hand rolling albeit none too efficient. The tea market still demands the traditional twisted appearance originally imparted by hand and to neglect this fact is equivalent to banging one's head against a brick wall.

The sale of crops under contract, and the deficit in supply as compared to the demand for tea in the world's markets, has undoubtedly caused some relaxation in standards. In any case, the harvesting of maximum crops resulting in harder plucking has made a lower standard of product inevitable.

The fact that a number of estates have found it possible to obtain satisfactory results from epicyclic rolling under these conditions does not necessarily mean that their teas will meet with full approval on the open market. As soon as buyers are able to discriminate in their purchases, it is quite probable that fine points such as "make," blackness, tip and so on may cause discrimination between equally good drinking teas. Competition between dealers who buy teas for appearance as well as liquor and blenders whose requirements in the matter of appearance are less exacting, may also confuse a situation which has always been rather obscure to the planter and teamaker. If the United Kingdom continues to buy on contract and the blenders obtain their supplies from this source leaving open markets in Colombo and Calcutta, in which dealers predominate, the situation will be quite unpredictable.

Our advice has been to exercise the greatest caution in conversions to E.P. rolling. This advice has been widely disregarded and, in our opinion, comparatively few conversions can be regarded as fully satisfactory including those carried out by engineering firms. In the case of some "home-made" fittings it is highly probable that results will prove disastrous on an open market. Some estates may have decided to take immediate advantage of the possible economies when both labour and machinery supplies have been difficult and of indifferent quality. So long as these changes have been made as a temporary measure all is well, but some E.P. fittings now in use may have to be modified considerably to satisfy the requirements of an open market.

Our experiments indicate that it is comparatively simple to devise E.P. fittings which will give high dhool out-turn and get through the work in the rolling room cheaply and quickly. It is less easy to devise fittings which will combine these advantages with good liquoring qualities, although a few experiments will usually suffice to meet this added requirement. The combination of economy of rolling with good liquoring qualities and fine appearance is a different matter altogether.

Many estates employing E.P. rolling are turning out choppy and flaky teas which may rapidly bring E.P. rolling into disrepute when the tea market begins to discriminate.

In the early part of the year E.P. fittings designed and tested on the experimental rollers were fitted to the commercial machinery in St. Coombs factory. Modifications were made until the tea produced were indistinguishable (to Colombo Tasters) from those rolled in rollers fitted with battens and pressure caps. On the return of the Biochemist from leave plans were made to carry out tests on other types and sizes of rollers. Provided that it is possible to carry out extended tests on an open market it should be possible to make definite recommendations during 1947.

Recent experiments on E.P. rolling have shewn that everything depends on the first roll. If a twist is not obtained in the first roll, subsequent rolls will produce choppy and flaky teas. Dhool production in the first roll is of secondary importance and indeed the requirements twist, and dhool production, are largely opposed to one another. A fitting with dhool producing action will tear the leaf very rapidly in the first few minutes of a first roll and twist cannot be imparted to small fragments of torn leaf. The first roll fitting must therefore be free of cutting and tearing action and must cause the leaf to circulate rapidly so that the friction between the flushes causes them to roll up into cylinders. Once these cylinders are formed, the power requirement of the roller falls rapidly as the resistance to the motion of the roller is greatly reduced. The expression of juice by the twisting action increases friction and if this is delayed it is possible to observe a second rise in power consumption due to "stickiness" of expressed juice. Twist is also dependent on an adequate charge as the weight of leaf pressing down on the epicyclic pressure gap is another important factor in increasing friction. Too light a charge is apt to give very disappointing results.

Within the limits of the mechanical strength of a roller and its driving arrangements, a high rate of charge is an advantage as it increases the working capacity of a roller and does not do any harm as the circulation is free and the leaf does not overheat.



On the whole E.P. rollers are more sensitive to changes in the degree of wither than batten/pressure cap rollers. If the wither is too soft, there is an inherent tendency to flakiness owing to the brittleness of the leaf, apart from which the juice expressed is not sticky enough to develop the required amount of friction. If the wither is too hard, the roller will often jam (or throw off a belt drive), the leaf tears to pieces and the "bloom" is taken off the leaf resulting in grey or reddish grey appearance. Both over and under-withering will result in flakiness and redness of leaf. The ideal wither for E.P. rolling is a medium soft wither giving an out-turn of made tea to withered leaf of about 45 per cent.

If a good tight twist is produced in the first roll, dhool may be produced quite rapidly in the second and third rolls without detriment to appearance. It appears necessary, however, to avoid sharp cutting edges on the fittings employed. Satisfactory results are obtainable with up to 15-20 per cent 1st dhool, 30-35 per cent second dhool and 35-40 per cent third dhool in three twenty-minute rolls. The dhools refer to sifting on Nos. 5 and 6 mesh.

Grading percentages are not affected by E.P. rolling as compared to rolling on battens except that it is difficult to make a high percentage of orthodox Orange Pekoe.

**Long Term Experiments on Rolling.**---Exploratory work on rolling has been fairly fully described in the address of the Biochemist to the Ceylon Association in London. Briefly, it has proved possible to make a tea of passable appearance (from the point of view of Blender requirements) and good liquoring qualities direct from green leaf, without recourse to withering. Such teas can be made within two to three hours of plucking but are light and flaky and difficult to pack in packets of standard size. Future experiments will be planned to attempt improvement in both appearance and density.

It is of interest to record that representatives of the tea trade in London are, on the whole, less conservative in their attitude towards changes in tea manufacture than their counterparts in Colombo. Much encouragement was given to the Biochemist during his visit and there appears to be good grounds for the hope that radical simplification of the process of tea manufacture are actually feasible.

For further work on rapid methods of manufacture a new machine was ordered from Messrs. Robertsons of Bedford after consultation with the makers and with Mr. Clive Meares on whose machine the previous work had been carried out. The Clivemeare roller was originally designed for treatment of withered leaf and its application to green leaf makes certain mechanical modifications desirable. The Biochemist also met Mr. Napier-Ford and Mr. E. J. Nicholls in London.

Mr. Napier-Ford has introduced the Legge Tobacco Cutter for use in tea manufacture in N. India and teas made direct from green leaf on a commercial scale are in production in that area. Mr. Napier Ford has loaned the T.R.I. a small machine for experiments with his method.

Mr. E. J. Nicholls has invented a machine which is also stated to be suitable for treatment of green leaf. Production of this machine for use



in N. India is also in progress and we hope that a machine may also become available for experiments in Ceylon.

**Firing.**—The Direct-Fired Heater in use on the commercial side of St. Coombs factory continued to give satisfactory service. Experiments with a different type of oil burner commenced towards the end of the year.

**Manufacture of Clonal Leaf.**—The manufacture of leaf from 58 clones under investigation by the Plant Physiologist was carried out during the year. Results were consistent and the method employed appears to be fully satisfactory.

#### ACKNOWLEDGMENTS.

The Biochemist wishes to acknowledge the help received from Tea Tasters both in Colombo and London. The tasting of experimental samples take much more than the usual time for samples and we frequently have a list of questions for answer. Since, however, all our work on manufacture ultimately depends on tea tasters' opinions, it is frequently necessary for us to ask for this help which is invariably ungrudgingly given.

During my visits to London I also received much hospitality from representatives of all branches of the industry and for this I wish to make a personal acknowledgment. There can be few other industries where the discussion of research problems involves more pleasant personal associations.

J. LAMB,  
*Biochemist.*

# REPORT

OF

## THE SMALL-HOLDINGS OFFICER

GAMPOLA

FOR 1946

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The work done during the period under review has been very restricted due to more than one reason.

I took over duties at the beginning of January on demobilisation from the Army and a good part of the first half year was spent in trying to organise my transport as it was found difficult to convince the authorities that my work was of an essential nature and that a vehicle in road-worthy condition was necessary for the performance of my duties.

**Advisory Work.**—Having been away six years on military duty I had to re-establish myself with the restricted facilities I had for transport. I went round the different areas I normally worked in Uda-Palata, Udu-Nuwara and Yati-Nuwara meeting small-holders, discussing their problems under the much changed circumstances, attending Village Committee Meetings and Chief Headmen's Division Days, where one could contact the Village Headmen, who are always in a position to give one the conditions prevailing in the villages. On these visits every effort has been made to contact the owner of a particular small-holding and discuss his problems on the land and advise him accordingly. 60 villages were visited during the later part of the year.

**Fertilisers.**—The keenness to use artificial manure has grown considerably. It may be attributed to the following reasons (a) the realisation by small-holders that tea does make good progress with the help of these manures (b) financially just now small-holders can make the investment and wait for his return. 114 permits were issued to small-holders during the later part of the year.

**Food Production.**—Everywhere I went I noticed everyone making an effort in this direction. The emergency was there and it was considered very necessary that food crops should be grown anywhere and everywhere.

If a little more care were exercised, and the small-holder advised on correct lines as to where and how these food crops should be grown, a great many of the small-holdings that were in tea and tea alone, prior to this food drive, would not be in the very pitiable state they are in today, with hardly any income from the tea. They did get the food at a price and will continue to pay for haphazard work on food production. These

small-holders have lost what was a regular income from their tea. The need for this income was not felt during the war years — there were jobs, there was employment, and the very handsome wages paid them, the like of which they never knew before, bought them all their necessities and their luxuries. The loss of this regular income is gradually being felt as life once more returns to normal.

**Green Manure and Shade.**—Small-holders now realise the value of growing green manures on their holdings and this is regularly done in nearly every holding. In recent years there has been more keenness shown as *Gliricidias* make good cattle fodder grow fast and are saleable as firewood, *Albizzias* are even more popular and everyone grows them. In fact, on some small-holdings there are more *Albizzias* than are necessary which of course does more harm than good to the tea. There was, and there is still, a great demand for *Albizzias* as a timber out of which all our country tea chests are made.

**Plucking and Pruning.**—From observations I consider the village pruner as good as an estate pruner. The bad pruning seen is really due to the fault of the small-holder rather than the pruner. In nearly every case the pruning is done on contract and for a figure for which good pruning cannot be done and the work is not supervised — may be for the reason that the immediate usefulness of the tea bush disappears when once it is pruned. With careful supervision the village pruner is capable of a very good job of work — when it is made worth while. A number of these pruners find fairly regular work on estates.

The plucking will never improve on a majority of small-holdings for two reasons (a) when prices are good every leaf harvested counts, so when the plucking date comes round every leaf must be plucked and only stalk left on the bush (b) the false impression that small-holders have that they can harvest larger crops when leaf is allowed to run coarse and a stem left nearly a foot long! When this happens the natural result is bad plucking.

Every effort is being made during visits to impress on smallholders how very necessary it is to prune and pluck well. In many cases the pruning has had my personal supervision; in the case of those small-holders who inform me when their fields are due for pruning I go round and help and supervise the pruning.

**Effect of the War.**—On my return I was glad to see that the war had had good effects on some small-holders and their holdings. They looked more prosperous, in fact they were, they had new houses substantially built, taking the place of the old wattle and daub building, their tea small-holding had had more attention paid, with more systematic work. There were others who had formed new trades, employments and benefited by them. The trade in tea chests seemed to be the most popular one.

A number of them had the opportunity of getting employment on very good terms in military establishments which helped them considerably and they were able to get over such difficulties as to debt, etc. The war years definitely brought in more prosperity and small-holders flourished during this period — in spite of a rationed staple diet,

**Labour.**—During the war years, and still, this continues to be a problem to the small-holders who depend on hired labour for their work. High wages are demanded, far above the standard wage, as the conditions on which labour is employed are those governing "Casual labour" — small-holders not being able to find employment throughout a month for their labour. This may be a result of the war and we hope it may settle down to the satisfaction of all concerned.

**Weather.**—Like everything the weather too has had its peculiar changes and has not helped the small-holders in their various cultivations. New plantations and supplies suffered considerably as a result of the failure of the monsoons.

**General.**—Conditions all over are getting back to normal very rapidly and, given better conditions, the work on small-holdings should continue to progress.

Prices paid for green leaf have been very satisfactory, leaving a fair margin of profit, even with increased costs.

I have to thank the Chief and Minor Village Headmen for their very willing co-operation in my work in spite of the many duties they are called upon to perform with numerous 'controls' and 'emergency measures' which could be done away with.

R. L. ILLANKOON,  
*Small-Holdings Officer, Gampola.*



# REPORT

OF

## THE SMALL-HOLDINGS OFFICER

BADDEGAMA

FOR 1946

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**Working Area.**—Advisory duties were chiefly confined to the Gangabodde and Talpe Pattus in Galle District. 699 visits were made to small-holdings, and 180 demonstrations carried out. The meagre petrol ration, and lack of good tyres, prevented intensive visiting, so necessary to maintain interest among small-holders.

The background against which advisory work was performed was one of economic dislocation. Small-holders had perforce to give priority to food production activities, and had little time for other work. Labour was short. A good part of it was absorbed in Government Schemes, with attractive rates of pay. What labour was available demanded high rates, which the average small-holder found difficult to pay. Costs of living continued to go up. Poverty, ill-health and malnutrition, dogged the small-holders' efforts and uneconomic green leaf prices prevailed.

**Instructional Leaflets.**—Instructional leaflets in Sinhalese were sent to small-holders in areas which could not be visited. These leaflets contained useful advice on the management of small-holdings.

**Division of Duties.**—About the middle of the year, another officer was appointed to the Southern Province with responsibility for the Matara District and Hinidum Pattu. On his visit to Baddegama, he was given all available information about his working area.

**New Planting.**—Several small-holders had obtained permits to plant tea in new areas. Those small-holders who had participated in the competitions held in these areas were able to apply the methods learnt to these new clearings. The poverty of the soil in most cases retarded the successful establishment of the tea.

**Rubber and Tea.**—On the assumption that rubber would continue to fetch good prices for a long time, some small-holders were observed planting rubber in their tea holdings. The adverse effect that this would have on the tea was carefully explained to them. But the speculative instinct was too strong for this timely advice to be heeded. The tea has deteriorated considerably, while the rubber is far from promising, and its long range prospects doubtful.

**Vegetative Propagation.**—Some small-holders who evinced interest in this matter were encouraged to start nurseries. The beds were carefully

prepared as advised. Gravel and good top soil was used in the preparation of the beds. In some cases the soil had to be brought from a distance. Coconut husks were used to hold up the sides of the beds. In one case the small-holder has raised plants, which, on the writer's last visit, were about 2 feet high. The mother bushes were selected from the holding itself.

**Supplying.**—Extensive supplying of vacancies was carried out in some small-holdings. The owners were encouraged to dip the germinated seed into a thick paste of dung and water before planting.

**Pruning.**—Lung pruning is generally practised in the areas where competitions have been held. Where the owner himself does the pruning, very careful work is done, though more time is taken. Where hired labour is employed there is a tendency to leave fewer lungs. Small-holders have been advised against the premature removal of lungs. In some cases tar or Candarsan has been applied to the larger pruning cuts.

**Plucking.**—Here too, where the family members pluck, the work is carefully done. The same cannot be said of the work done by hired pluckers. Some of the small-holders take the leaf themselves to the factory, while others arrange for its collection by the factory. The standard of plucking in the competition holdings is generally satisfactory.

**Green Manures.**—The planting, training, and proper utilisation of green manures has been an important aspect of advisory work. Most small-holdings now have *Albizzia* and *Gliricidia*, with *Indigofera* and Gotukola (*Centella asiatica*) as ground covers. *Gliricidia* in boundaries has also been encouraged, there being a great demand for *Gliricidia* for feeding goats. Thefts of *Gliricidia* cuttings from small-holdings were all too common. The depredators, by wanton hacking, ruined the trees, and replanting was frequently necessary.

**Contour Hedges.**—A *Clitoria* species was found growing wild locally. This and wild sunflower proved very useful in contour hedges to check erosion. Both stood lopping well. Loppings were used for composting and as a mulch.

**Composting.**—Small-holders have been taught composting on the 3-pit system, which ensures a regular supply of well made compost. The value of getting green material for composting from outside the holding has been explained to them. Dung and discarded straw are also used.

**Manuring.**—Some small-holders use compost for forking in, while others use fertilisers. Those who wanted the latter were given every assistance to obtain permits. In some small-holdings, straw is forked in, after it has broken down thoroughly, along with leaf-fall from prunings, when available.

**Erosion.**—This is one of the most serious problems in the majority of small-holdings. For decades, the soil has been impoverished, through the improvidence and inexperience of its owners. In the circumstances, the establishment of supplies and even of *Gliricidia* has often been difficult. Small-holders have been taught various methods of checking erosion. Even coconut husks, turf, and trunks of trees have been used for the purpose, when stones were not available. In some small-holdings, all the existing stone terraces were repaired, and extensive new terracing put in.



Existing drains have been improved. When cutting or clearing drains, the importance of putting earth and silt on the upper side, and holding it there, has been stressed.

Small-holders are advised to hand weed at frequent intervals, instead of neglecting weeding for long periods and then resorting to the drastic method of mamoty weeding.

**Conveyance.**—The deterioration of road surfaces, which began during the war years, has yet to be arrested. Maintenance costs of cars therefore continue to be high. There has been no increase in the monthly petrol ration despite efforts to get this increased.

**Competitions.**—Owing to the war, and the difficult conditions created thereby, the plans for the holding of tea small-holdings competitions for this area had to be held in abeyance. They will be restarted in 1947 and it is hoped that they will act as a stimulus and so improve the work in the holdings.

**General.**—The policy followed has been one of doing a little well and gradually expanding instead of trying to cover large areas and thereby inviting superficial work.

It is never easy to gain the small-holders' confidence. When confronted with facts and figures of better yields through the use of scientific methods, he will point to the substantial resources of the Institute, which, unlike him, can afford to spend money. For this reason demonstration plots owned and worked by the Institute can have little value. Our efforts have to be concentrated on such small-holders as are receptive to new ideas and are willing to improve their holdings and so to demonstrate the value of our advice and methods.

**Acknowledgments.**—The Mudaliyar of Talpe Pattu and the Divisional Revenue Officer of Gangabodde Pattu, have always been extremely helpful. Mr. W. Amerasinghe of Leo Group, Nathewela, whose knowledge of men and matters in these parts is unrivalled, continues to give very valuable support. He has done so consistently since 1938. He has been a keen participant in all small-holdings activities. Village Committees and Headmen have also given their co-operation.

To all of them I convey my sincere thanks.

F. D. TILLEKERATNE,  
*Small-Holdings Officer, Baddegama.*



# The Tea Research Institute of Ceylon.

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